■ **MEASURE STATION**

# ENERIUM

**FRENCH**

**User Manual**

ENERDIS®
CHAUVIN ARNOUX GROUP

# Table of contents


**INTRODUCTION ..... 5**

**1. AIM OF THE MANUAL ..... 7**

**2. SAFETY ..... 8**

**3. GUARANTEE, RESPONSIBILITY AND PROPERTY ..... 9**
3.1 Guarantee ..... 9
3.2 Property rights ..... 9
3.3 Copyright ..... 9
3.4 Registered trademarks ..... 9
3.5 End-of-life of the devices ..... 9

**4. PACKAGING ..... 10**

**EQUIPMENT DESCRIPTION ..... 11**

**5. GENERAL PRESENTATION ..... 13**
5.1 Presentation ..... 13
5.2 Model Comparison ..... 14

**6. FRONT FACE ..... 15**
6.1 Elements ..... 15
6.2 LCD Screen ..... 15
6.3 Optical Interface ..... 16
6.4 Optical Cable ..... 17
6.5 OK Key ..... 17
6.6 Navigation Keys ..... 17

**7. BACK FACE ..... 19**
7.1 Elements ..... 19
7.2 Measurement terminal ..... 19
7.3 Auxiliary source terminal ..... 20
7.4 Optional cards ..... 20
7.5 RS485 terminal ..... 21
7.6 *Ethernet Connector* ..... 22

**SOFTWARE DESCRIPTION ..... 23**

**8. MAIN SCREEN ..... 25**
8.1 Home Screen ..... 25
8.2 Main Menu ..... 25
8.3 Abbreviations ..... 26
8.4 Synoptic of the menus ..... 26

**9. MEASUREMENTS (SCREEN) ..... 29**
9.1 Access ..... 29
9.2 ''Measurements'' screen ..... 29
9.3 Information ..... 29
9.4 Return ..... 31
9.5 Notes ..... 31

**10. ENERGIES (SCREEN) ..... 33**
10.1 Access ..... 33
10.2 ''Energy'' Screen ..... 33
10.3 Information ..... 33
10.4 Return ..... 34
10.5 Notes ..... 35

**11. SERVICES (SCREEN) ..... 37**
11.1 Access ..... 37
11.2 "Services" Screen ..... 37
11.3 Information ..... 37
11.4 Return ..... 38

**12. (SCREEN) ALARMS ..... 39**
12.1 Access ..... 39
12.2 "Alarms'' Screen ..... 39
12.3 Information ..... 39
12.4 Return ..... 40

**13. CUSTOMIZED SCREENS ..... 41**
13.1 Access ..... 41
13.2 "Customized Screens'' Screen ..... 41
13.3 Principle ..... 41
13.4 Screens ..... 41
13.5 Return ..... 42

**14. (SCREEN) CONFIGURATION ..... 43**
14.1 Access ..... 43
14.2 ''Configuration '' screen ..... 43
14.3 Remote Communication RS 485 ..... 43
14.4 Remote Ethernet Communication ..... 44
14.5 Display ..... 45
14.6 Electrical Network ..... 46
14.7 Default values ..... 47
14.8 Notes ..... 47

**15. HARMONICS ..... 49**
15.1 Access ..... 49
15.2 ''Harmonics'' Screen ..... 49
15.3 Return ..... 50

**16. FRESNEL AND GAUGES ..... 51**

16.1 Access ..... 51
16.2 “Fresnel and gauges’’ Screen ..... 51
16.3 Return ..... 53

**17. LOAD CURVES ..... 55**

**18. RECORDING CURVES ..... 57**
18.1 Recorded variables ..... 57
18.2 Synchronization modes ..... 57
18.3 Operating modes of recording curves ..... 57
18.4 Indicators of the recording curve ..... 58

**INSTALLATION ..... 59**

**19. MECHANICAL ASSEMBLY ..... 61**
19.1 Cutting ..... 61
Operations: Continuation ..... 61

**20. ELECTRICAL CONNECTION ..... 63**
20.1 Preliminary notes ..... 63
20.2 Connection of voltage and current inputs 63
20.3 RS485 Connection ..... 65
20.4 *Ethernet* Connection ..... 66
20.5 Connection of input and output cards ..... 67
20.6 Connection of the auxiliary source ..... 68

**USE 69**

**21. OPERATING PROCEDURE ..... 71**
21.1 Complete Procedure ..... 71
21.2 How to … ..... 71

**22. LOCALE OR REMOTE COMMUNICATION . 73**
22.1 *E.set* and *E.view* applications ..... 73
22.2 ModBus/RTU compatible specific application ..... 73

**23. MAINTENANCE ..... 75**

**TECHNICAL CHARACTERISTICS ..... 77**

**24. CHARACTERISTICS ..... 79**
24.1 Measurements ..... 79
24.2 Load curves ..... 80
24.3 Alarms ..... 80
24.4 Analog outputs ..... 80
24.5 Recording curves ..... 80
24.6 Electrical ..... 81
24.7 Optional cards ..... 82
24.8 Metrology ..... 83
24.9 Mechanical ..... 84
24.10 Environmental constraints ..... 85
24.11 Accessories ..... 85

**25. MEASURED VARIABLES ..... 87**
25.1 Ground voltage ..... 87
25.2 Line voltages ..... 87
25.3 Current ..... 87
25.4 Active power ..... 87
25.5 Transit direction of powers ..... 88
25.6 Reactive power ..... 88
25.7 Apparent Power ..... 88
25.8 Power factor ..... 88
25.9 Cos(φ) ..... 88
25.10 Peak factor ..... 89
25.11 Tan(φ) ..... 89
25.12 Frequency ..... 89
25.13 Harmonics ..... 89
25.14 Harmonics rate ..... 89
25.15 Energy and Energy metering ..... 90
25.16 Unbalance ..... 90
25.17 Phase order ..... 90
25.18 Time meter ..... 91
25.19 Average variable ..... 91
25.20 Calculation of minima ..... 92
25.21 Minima of variables ..... 92
25.22 Minima of average variables ..... 92
25.23 Calculation of maxima ..... 92
25.24 Maxima of variables ..... 93
25.25 Maxima of average variables ..... 93

**26. INDEX ..... 95**

# Introduction

# 1. AIM OF THE MANUAL

This manual is meant for any person wishing to use an *ENERIUM 50* or *ENERIUM 150* Central Readout Station for the measurement of network variables (V, U, I, F, P, Q, S, FP, tg $\phi$, THD, etc.) and energy variables.

The present manual informs about:

- The product functions
- Product implementation and use
- Product characteristics

The *ENERDIS* Company has printed this manual with the purpose to provide simple and precise information.

*The ENERDIS* Company does not assume any responsibility for any wrong interpretation. Although all efforts have been made to offer a manual as precise as possible, the latter may however include technical inaccuracies and/or typographical errors.

The product owner must keep this manual for the entire duration of the product's use.

Any information or modification pertaining to this manual should be addressed to:

**ENERDIS**
Publication Manager
1 - 9 Rue d'Arcueil
BP 675
92542 MONTROUGE Cedex
FRANCE

# 2. SAFETY

You have just acquired an ENERIUM Measure station of *50* or *150* type and we thank you for trusting our company and products.

To obtain the best service from your device:

- Read this operation notice carefully;
- Follow the precautions for usage which are mentioned in it.

Meaning of the symbol. Caution! Read the reference manual carefully before using the device. In this reference manual, if the instructions preceded by this symbol are not followed or executed well, they can cause a bodily injury and damage the device and the installations.

This device is meant to be used as per the conditions of the installation category III, degree of pollution 2, complying with the provisions of the CEI 61010-1 standard. It has come out of the plant in perfect conditions of technical safety. In order to preserve these conditions and guarantee a safe use of the device, the user should comply with the indications and the symbols contained in this manual.

Before the installation, check the voltage for use and the coincidental network voltage.

Before any intervention, check that the device is disconnected from all the voltage sources.

When use in total safety is no longer possible, the device should be disabled and insured against an accidental use.

The use in total safety is no longer guaranteed in the following cases:

- The device is visibly damaged,
- The device no longer operates:
  - after prolonged storage in unfavorable conditions;
  - after serious damages inflicted during transport.

### Operators' Safety

**Read the following recommendations carefully before installing the device.**

The device described in this manual is meant to be used exclusively by personnel trained beforehand. The maintenance operations must be exclusively executed by qualified and authorized personnel. For a correct and safe use and for all maintenance activities, it is essential that the personnel follow the normal safety procedures.

### Precautions in case of breakdown

When it is suspected that the device is no longer safe (for example due to damages inflicted during transport or at the time of its use), it should be disabled. It is necessary to ensure that it will not be used accidentally. The device will be entrusted to authorized technicians with a view to inspect it.

### Instruction for installation

On receipt of the device, check that it is intact and has not been subjected to any damage during transport. In case of problem, contact the after-sales service for possible repair or replacement.

### Instruction for cleaning

When the device is disconnected from the electricity network, use only a dry rag to clean the external surface. Do not use either abrasive products or solvents. Do not wet the connection terminals.

# 3. GUARANTEE, RESPONSIBILITY AND PROPERTY

## 3.1 Guarantee

The guarantee is applicable, except for express stipulation, during twelve months after the installation of the equipment (see our General Sales Conditions, communicated on request).

## 3.2 Property rights

All manuals and documentation of any nature whatever are the property of *ENERDIS* and are protected by copyright, all rights reserved. They cannot be distributed, translated or reproduced, in whole or in part, in whichever manner and under whichever form.

## 3.3 Copyright

All Rights reserved. Reproduction, adaptation or translation of the present manual is prohibited without prior authorization, within the limits envisaged by the legislation governing the copyright rights.

Copyright ENERDIS – 2007.

First edition, September 2007.

## 3.4 Registered trademarks

*ENERIUM* is a trademark registered by *ENERDIS*.

## 3.5 End-of-life of the devices

The products that we market do not enter the domain of the decree no.2005-829 pertaining to the composition of electrical equipments and elimination of waste originating from these equipments.

In compliance with article L541-2 of the environment code, it is the responsibility of the holder of the waste to ensure it or ensure the elimination.

# 4. PACKAGING

The equipment is delivered as per your order. It shall, at the minimum, include the following articles:

| Name | Qty |
|---|---|
| *ENERIUM* Measure Station<br>Type *50* or *150*. | 1 |
| CD ROM containing:<br>- the present manual in PDF format<br>- *E.set* configuration software<br>- USB driver for the optical head accessory | 1 |
| Simplified commissioning manual (A4 format) | 1 |
| Plastic bag with the equipment, varying according to the model | 1 |
| Attachment parts on a panel for the ENERIUM *50 or 150* models | 2 |

**Variable equipment**

| Name | Qty |
|---|---|
| Detachable Connector(s) associated with optional cards | 0 to 2 |

# Equipment Description

# 5. GENERAL PRESENTATION

## 5.1 Presentation

*ENERIUM* is a measure station in 96 x 96 format, complying with the DIN 43700 standard, for all types of electrical networks, meant for all measurement applications, display and supervision of low and medium voltage networks.

*The ENERIUM* Central readout station is aimed for companies managing the monitoring and reduction of energy costs in an environmental framework and for sustainable development, as well as for industries having complex electrical networks justifying monitoring and accurate calculation.

Thus, more than 50 network variables (U, V, I, P, Q, S, FP, tg $\phi$, THD, active, reactive and effective energy, THD, etc.) are analyzed.

The information gathered is available on the front of the device by means of a graphical monochrome LCD display, as well as a On/Off output of RS485 type as per the ModBus/RTU protocol or Ethernet as per *ModBus*/TCP RTU protocol, whereas one or several optional outputs provide an alarm report which delivers metering pulses or manages analog outputs.

Its programming enables a precise adaptation of the device to the environment.

The measure station comes in two models named *ENERIUM 50* and *ENERIUM 150*.

*General view of the ENERIUM 150 readout station*

## 5.2 Model Comparison

The table presented below gives the main features of versions 50 and 150. The detailed technical and electrical characteristics are part of chapter 24 on page 79.

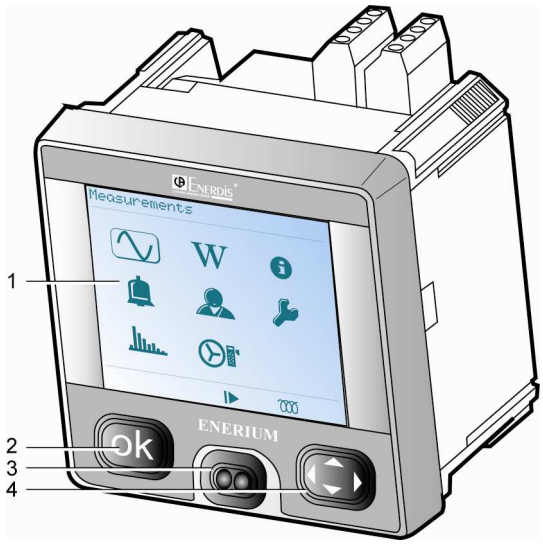
| | ***ENERIUM 50*** | ***ENERIUM 150*** |
|---|---|---|
| ***Measurements*** | | |
| Calculation of the neutral current | Yes | |
| 3 or 4 wire network management | Yes | |
| Tan $\phi$ | Yes | |
| Harmonic range | 25 | 50 |
| 400 Hz Network | Yes | |
| ***Graphic User Interface*** | | |
| Customizable screens | Yes | |
| ***Input-output cards (I/O)*** | | |
| Optional card (1) | 1 | |
| ***Alarms*** | | |
| Elementary alarms | 16 | |
| General Alarms | 8 | |
| Event log FIFO | Yes | |
| ***Curves*** | | |
| Load curve | 8 variables from among possible 10 (2) | |
| Recording curves | No | Yes |
| ***Communication Interface*** | | |
| Optical (front face) | Yes | |
| Ethernet (ModBus / TCP RTU) (3) | Yes | |
| RS 485 (ModBus RTU) (3) | Yes | |
| IP address parametering in front | Yes | |
| ***Graphics*** | | |
| Fresnel Diagram | No | Yes |
| Gauges | No | Yes |
| Histograms (harmonics) | No | Yes |

*(1) The optional cards are: 2 analog outputs, 2 On/Off outputs, 2 On/Off inputs and 1 On/Off input+ 1 On/Off output.*
*(2) P+, P-, Q1, Q2, Q3, Q4, S+, S-, E-TOR1, E-TOR2.*
*(3) The communication interfaces RS 485 and Ethernet cannot be used simultaneously.*

# 6. FRONT FACE

## 6.1 Elements

This paragraph presents the elements accessible in the front face for each of the two available models.




*Front View of the 'ENERIUM 50 or 150.*

| Ref. | Function | See § |
|---|---|---|
| 1. | LCD display screen. | 6.2 |
| 2. | **OK** Validation key | 6.5 |
| 3. | Optical interface | 6.3 |
| 4. | Navigation keys | 6.6 |

## 6.2 LCD Screen

This screen displays:

- All the measured and calculated variables (see chapters 9 to 13 in pages 29 to 41)
- All parametering variables (see chapter 14, in page 43).

The positive, transmitting type LCD screen is a graphic display module, permanently back-lit by white LEDs.

The contrast is adjustable locally or by the transmission of a command word from a local or remote communication. This adjustment is possible directly with the *E.set* or *E.view* software (refer to the corresponding notice).

The main menu is presented as follows:

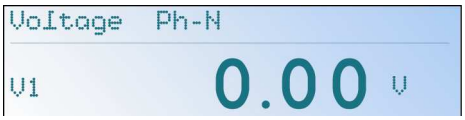
*The main menu.*

All the displayed screens can be viewed, in one of the five languages available (French, English, German, Italian and Spanish). The language can be modified (see paragraph 14.5.3, in page 45).

For *ENERIUM 50*, the icons and are not available.

### 6.2.1 Upper part

The title of the displayed screen is in the upper part of all the screens ("Ph-N Voltage" in the figure below).




*Example of display with the screen title in the upper part*

### 6.2.2 Central part

The measurement menus as in the following examples are found here.

The detail of screens pertaining to:

- measurement, see chapters 9 to 13, pages 29 to 41.
- parametering, see chapter 14, page 43.

*The central part displays measurements.*

### 6.2.3 Lower part

It displays the information pictograms, from fixed position. These are listed in the following table.

The figure below gives all the icons that can be viewed in the lower part of the LCD screen.

*The icons in the lower part of the screen (visualization of all the icons for illustration only)*

| Icon | Meaning |
|---|---|
| | At least one active general alarm exists. Blinking Pictogram. |
| | Order of phases incorrect; the voltage wires are badly connected. Fixed Pictogram.<br>Verification of the order of phases of the voltage lines is carried out continuously. The calculation is done over 3 periods and the 10 periods of the reference input signal. |
| | Communication ongoing on one of the communication ports (remote or local). Blinking Pictogram. |
| | Automatic scrolling mode of the active screens. Fixed Pictogram. |
| | Capacitive type network. Fixed Pictogram.<br>This pictogram has the same screen position as the next pictogram. |
| | Inductive type network. Fixed Pictogram.<br>This pictogram has the same screen position as the preceding. |
| | Generator network. There is no pictogram for a receiver network. Fixed Pictogram. |

### 6.2.4 Additional Information

Upon powering up the measure station, a home screen is displayed for a few seconds. This screen is displays the *ENERDIS* logo and the station model. The last screen then appears, displayed before the last break of the auxiliary source. If the last screen displayed was a parametering screen, it is the main menu which is displayed.

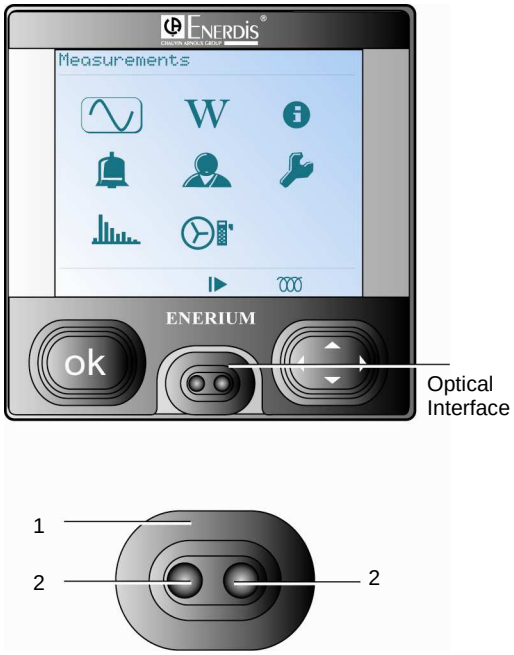
It is also possible to read the screen number displayed in the *ModBus* memory field. It is also possible to force the display of a screen by sending a command word thru a local or remote communication (see document MSO-7388 - Mapping and command words – Contact *ENERDIS* to obtain this document).

When no action has been detected on the keys for more than 3 minutes, the display back-light is switched into standby mode.

## 6.3 Optical Interface

### 6.3.1 Presentation

The optical interface is made of the following elements:




| Ref. | Function |
|---|---|
| 1. | Positioning device. |
| 2. | Infrared communication emitter and receiver. |

*Close view of the front optical interface.*

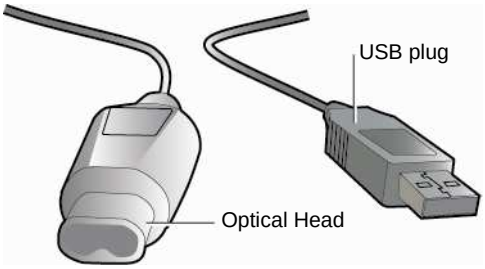
### 6.3.2 Function

The optical interface allows parametering and reading the measurements recorded by *ENERIUM* locally from a PCusing an optical cable (see paragraph 6.4, page 17).

## 6.4 Optical Cable

The optical cable is an accessory, sold separately, which is connected to *ENERIUM* optical interface in order to transfer information between a PC and *ENERIUM*. The USB type connecOn/Off side of the optical cable is connected to the PC. The communication protocol between *ENERIUM* and the PC uses a *ModBus* in RTU mode.

For the communication parametering, see chapter 22, page 73.




*The optical cable.*

## 6.5 OK Key

This key validates the selected choice or the entered parameters. It also enables the input or output of the editing mode.

*Position of the OK key.*

## 6.6 Navigation Keys

These keys enable the navigation in the different menus.

### 6.6.1 Function

| Key | Function |
|---|---|
| ◁ | Leftward movement of the cursor<br>Return to the previous menu |
| ▷ | Rightward movement of the cursor |
| ▽ | Menu: downward movement of the cursor<br>Parametering: value decrementation |
| △ | Menu: upward movement of the cursor<br>Parametering: value incrementation |

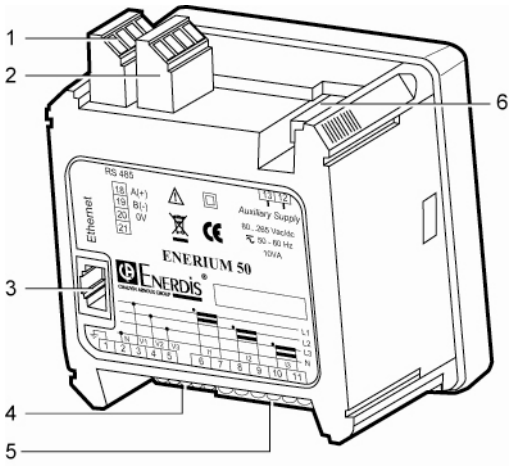
### 6.6.2 Use

The diagram of paragraph 8.4 on page 26 specifies the use of the navigation keys for the selection of menus.

# 7. BACK FACE

## 7.1 Elements

The figure below shows the elements described in this chapter.




*Back view of ENERIUM for all versions.*

| Ref. | Function | See § | Page |
|---|---|---|---|
| 1. | RS485 terminal (if no Ethernet connector). | 7.5 | 21 |
| 2. | Optional card terminal. | 7.4 | 20 |
| 3. | Ethernet Connector (if no RS485 terminal). | 7.6 | 22 |
| 4. | ''Voltage'' input terminals. | 7.2.1 | 19 |
| 5. | ''Current'' input terminals. | 7.2.2 | 19 |
| 6. | Auxiliary source terminal. | 7.3 | 20 |

## 7.2 Measurement terminal

The network monitoring inputs, namely those monitoring the line voltages and those originating from the current transformers, will be connected on this terminal.

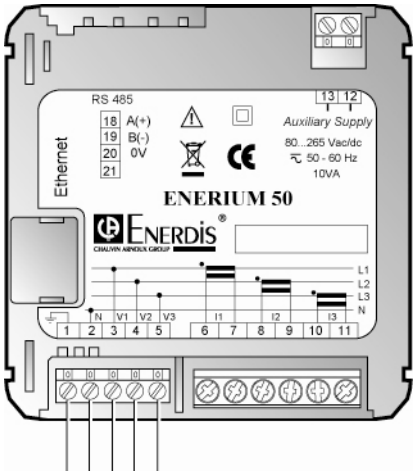
Paragraph 20.2 on page 63 describes the different authorized connections.

### 7.2.1 Voltage inputs

The "Voltage input'' terminals are marked 1 to 5 on the label on the rear part of *ENERIUM*.

The electrical characteristics of the voltage inputs are given in paragraph 24.6.3 page 81.

The terminal characteristics are given in paragraph 24.6.3 on page 81.



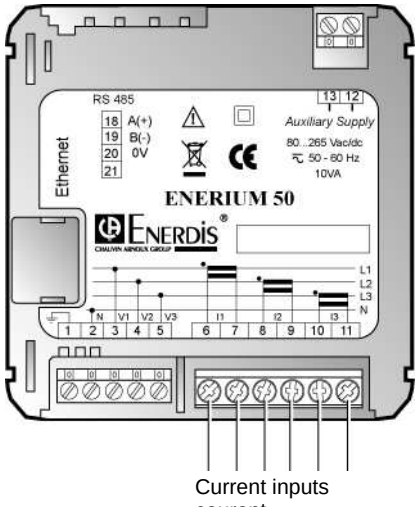

*Detail of the voltage input terminals.*

### 7.2.2 Current inputs

The ''Current input'' terminals are marked 6 to 11 on the label on the rear part of *ENERIUM*.

The electrical characteristics of the current inputs are given in paragraph 24.6.4 page 81.

The terminal characteristics are given in paragraph 24.6.4 page 81.




*Detail of the current input terminals.*

# 7.3 Auxiliary source terminal

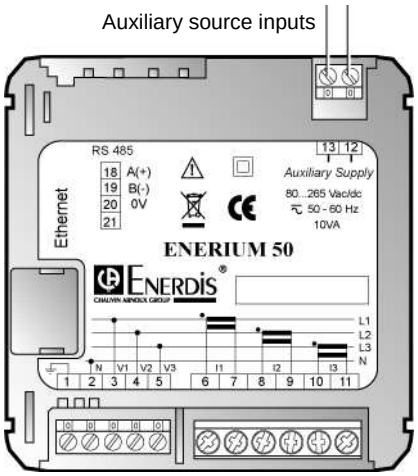
The ''Auxiliary source'' terminals are marked 12 and 13 on the rear part of *ENERIUM*.

Two types of power supplies are available:

- ***High voltage power supply***: the supply is made without preference on the same terminals (no change), for alternating or direct current.
- ***Low voltage direct power supply***: the supply is exclusively made with DC. The polarity is free.

The electrical characteristics of the supplies are given in paragraph 24.6.6 page 82.

The characteristics of the terminals are given in paragraph 24.6.6 page 82.




*Location of the auxiliary source terminal.*

In the case of a power cut of the auxiliary source, the strategic data are saved. See paragraph 24.6.7 page 82.

# 7.4 Optional cards

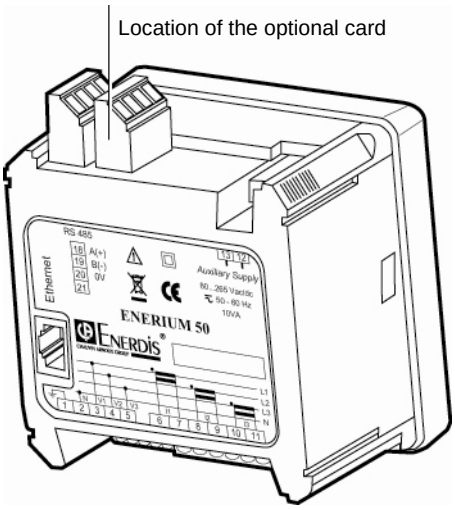
Four card models are available:

- 2 analog output card (paragraph 7.4.1);
- 2 On/Off output card (paragraph 7.4.2);
- 2 input card (paragraph 7.4.3);
- 1 input and 1 output card (paragraph 7.4.4).

An optional card can be installed inside *ENERIUM*. A cache protects the unused location.

The terminal of each of these cards is accessible in the upper part of *ENERIUM*.

The terminal characteristics are given in paragraph 24.7.1 page 82.




*Location of the optional cards.*

## 7.4.1 2 Analog output Card

This card has two independent analog outputs, each generating a direct current proportional to one of the *ENERIUM* variables. Using a local or remote link, the user may assign to each analog output:

- A variable to be monitored (V, U, I, P, Q, S, FP, cos (φ), Tan (φ) and frequency)
- Min and max output values

The transfer function is always of single slope type. When the output variable reaches and exceeds the maximum output value, the output remains blocked at the maximum output value. When the output variable reaches and exceeds the minimum output value, the output remains blocked at the minimum output value.

It is possible to block an analog output with a value lying between the authorized minimum and maximum, by sending a command word over a local or remote communication. The output is blocked automatically at the end of 10 minutes or after the station restart.

The detail of the management of each of the two analog outputs (assigned variable, etc.) is defined by means of *ModBus* command words (see document *MSO-7388 – Mapping and command*. Contact *ENERDIS* to obtain this document).

The cabling details are given in paragraph 20.5.1 page 67.

The electrical characteristics of the analog outputs are given in paragraph 24.7.2 page 82. The analog output can remain open permanently.

## 7.4.2 2 On/Off output card

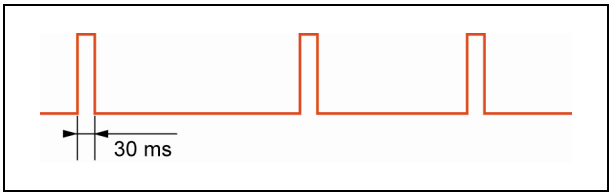
This card has two logic individual and independent outputs (digital), each programmable in either alarm or pulsed mode.

For each of these, the user assigns one or two output modes thru local or remote communication:

- ***Alarm mode***: the output is activated when a variable measured or calculated by *ENERIUM*

crosses a threshold (maximal or minimum) which is allocated to it, for a time longer than the configured time-lag. This elementary alarm is deactivated when the variable crosses the threshold again, with close hysteresis.

- ***Pulsed mode***: the pulse output is of relay type. In an off state, the relay is open. A pulse is considered emitted when the relay is closed. The pulses are counted from the energy in the primary side of the transformer. This metering can be directed to a pulse meter (for example the *CCT ENERDIS*).




*Example of chronogram in pulsed mode*

To manage the pulse output, this output must be associated (when parametering) with energy from among three-phase active energy in generator mode, three-phase active energy in receiver mode, three-phase reactive energy of quadrants 1, 2, 3, and 4 and three-phase effective energy in generator mode.

The pulse weight is also parameterable among the values 1, 10, 100, 1k, 10k and 100k.

The pulse width is common to all the outputs and it is programmable at 30 ms then from 50 to 500 ms, in steps of 50 ms, using a local or remote communication.

The pulse emission over one second is rounded to the nearest millisecond.

It is possible to block a pulse output in the High or Low state by sending a command word or thru the *E.set* and *E.view* software using a local or remote communication. The output is automatically unblocked after 10 minutes or after the station restart.

Each logic output is composed of a static rely ensuring isolation between the command and the output. This is a simple contact, which is closed to emit a pulse or activate an alarm.

The detail of the management of each of the two On/Off outputs (assigned variable, etc.) is defined using *ModBus* command words (see document *MSO-7388 – Mapping and command words*. Contact *ENERDIS* to obtain this document)

The cabling details are mentioned in paragraph 20.5.2, page 67.

The electrical characteristics of On/Off outputs are given in paragraph 20.5.2, on page 67.

### 7.4.3 2 On/Off -input Card

This card has two independent inputs (digital), each programmable in pulse or synchronisation mode. For each of these the user allocates one of the two input modes thru local or remote communication:

- ***Pulsed mode***: when the input is configured in *pulsed mode*, the received pulses are multiplied by the pulse weight on this input and are then added in an integrating meter. The weight of the pulse is parameterable from 0.0001 to 999.9999.

  It is possible to initialize the meters with any value by sending a command word (see document *MSO-7388 Mapping and command words*. Contact *ENERDIS* to obtain this document) or by the *E.set* and *E.view* software using a local or remote communication

- ***Synchronization input mode***: the input is used to synchronize the records or to run alarms. It can also serve to synchronize the *ENERIUM* internal alarm*;* the clock is then parametered as an external synchronization input. When a pulse is detected on this input, *ENERIUM* automatically sets the internal clock to the rounded-off hour (minutes and seconds are worth zero), if the internal clock has less than 5 seconds gap with the rounded-off hour. It is also possible to read the input status in the *ModBus* mapping (see document *MSO-7388 - Mapping and command words*. Contact *ENERDIS* to obtain this document).

The detail of the management of each of the two logic inputs (digital) is defined by means of *ModBus* command words (see document *MSO-7388 - Mapping and command words*. Contact *ENERDIS* to obtain this document)

The cabling detail is mentioned in paragraph 20.5.2 page 67.

The electrical characteristics of On/Off inputs are given in paragraph 24.7.3 page 82.

### 7.4.4 1 On/Off input and 1 On/Off output Card

This card has a single On/Off logic input and a single On/Off logic output.

The electrical characteristics of this card are similar to the “2 On/Off inputs’’ and “2 On/Off outputs” above.

## 7.5 RS485 terminal

Available optionally, this terminal is connected to the RS 485 bus.

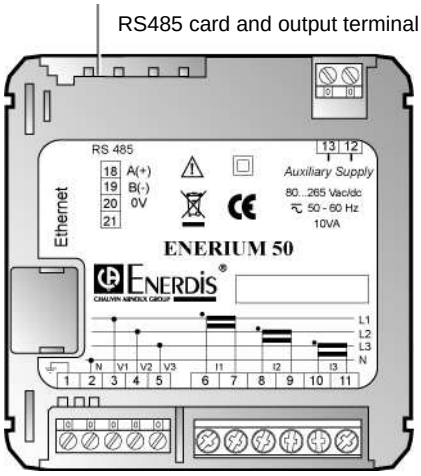
The RS 485 option is not available if the Ethernet option is available.

Parametering of the RS 485 option is given in paragraph 14.3 on page 43.

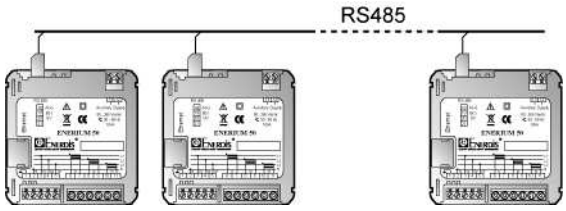
The characteristics of the terminals are given in paragraph 24.6.5, *RS 485 Output* page 81.

The RS 485 terminal ensures the transfer of information between the PC and *ENERIUM* in the framework of:

- parametering of *ENERIUM*
- reading of real time or recorded measurements in *ENERIUM*.




*Location of the terminal of the RS 485 card.*




*Up to 247 ENERIUMs can be linked on the same RS485 communication line.*

The cabling detail is mentioned in paragraph 20.3 page 65.

## 7.6 *Ethernet Connector*

Available optionally, this connector is connected to the local *Ethernet* network.

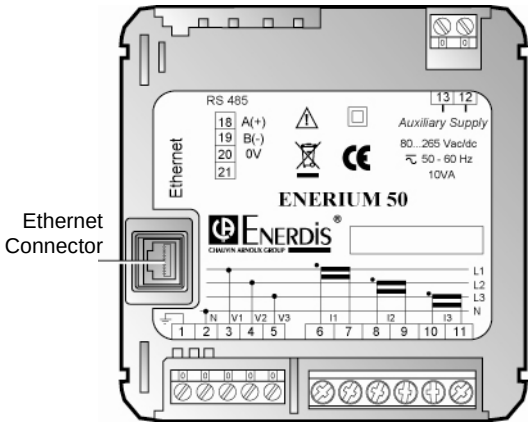
The Ethernet option is not available if the RS 485 option is available. .

The parametering of the Ethernet option is mentioned in paragraph 14.4 on page 44.

The connector characteristics are given in paragraph 24.6.5, *Ethernet Output* on page 81.

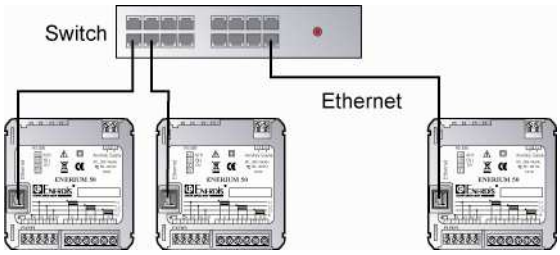
The Ethernet connector ensures the transfer of information between a PC and *ENERIUM* in case of*:*

- parametering of *ENERIUM*
- reading of the real time or saved measurements in *ENERIUM*.




*Location of the Ethernet connector.*

The cabling details are mentioned in paragraph 20.4, page 66.




Note: a twisted cable is recommended for direct communication between a PC and *ENERIUM*.

# Software Description

# 8. MAIN SCREEN

It is assumed here that the mechanical assembly (chapter 19 page 61) and electrical connections (chapter 20 page 63) have been performed.

This chapter describes the menus accessible by the operator from the main screen.

## 8.1 Home Screen

When powering up, a loading screen is displayed for a few seconds while all the station functions are being activated.

Under the "*Enerium 50*'' or "*Enerium 150*" line (depending on the model) a progress bar appears showing the status of the equipment loading process.

*The Home screen.*

## 8.2 Main Menu

The main menu is then displayed.

*Main menu.*

### 8.2.1 Icons

The main screen displays the eight menus (*only six menus on ENERIUM 50*) available to the operator thru icons (see the table below).

The upper part of the screen shows the selected icon name in the parametered language (see paragraph 14.5.3 page 45).

| Icon | Function | Page |
|---|---|---|
| | **Measurements**: displays the screen of the measured variables (U, I, P, THD, etc.). | 29 |
| | **Energy**: displays the screens of active, reactive and effective energy meters, cumulated by the station. | 33 |
| | **Services**: displays the screens of variables (the time meters for the device operating time and the internal time stamping) linked to the maintenance of the station. | 37 |
| | **Alarms**: displays the screens for alarm information (visualisation of alarm status and relays associated with On/Off outputs) and the existing alarm acknowledgement. | 39 |
| | **Customized screens**: displays the screens parameterable by the user thru local or remote communication. | 41 |
| | **Configuration**: displays the menu for configuration parameter changes (TP – TC ratio, communication, display scrolling, language, password). | 43 |
| | **Harmonics**: displays the harmonic amplitude of the range 1 to 50 in the form of histograms for the electrical variables V1, V2, V3, U12, U23, U31, I1, I2 and I3 (*ENERIUM 150 only*). | 49 |
| | **Fresnel and gauges**: displays the Fresnel diagrams of electrical variables V, U and I as well as the bar charts for the electrical variables V, U, I and P (*ENERIUM 150* only). | 51 |

| | |
|---|---|
| | Recall: the selection of an icon is made using navigation keys (see § 6.6 page 17).<br>When an icon is selected, its look changes by the appearance of a routing creating a relief button. |
| | The action on the "**OK**" key shows the menu related to the selected icon.<br>The "**Up**" and "**Down**" keys scroll between lines.<br>Pressing the "**OK**" key displays the selected screen. |

### 8.2.2 Icons at the bottom of the screen

These icons are located in the lower part of the different screens. They display the following information:

| Icon | Function |
|---|---|
| | At least one active global alarm. Blinking Pictogram. |
| | Wrong phase order; the voltage inputs are badly connected. Fixed Pictogram.<br>A cabling test thru verification of the phase order on the voltage lines is carried out continuously. The calculation is made over 3 periods and for all 10 periods of the reference signal input. |
|  | Communication ongoing on one of the communication ports (remote or local). Blinking Pictogram. |
| | Automatic scrolling mode of the screens active. Fixed Pictogram. |
| | Capacitive type network: this pictogram has the same position on the screen as the next pictogram. |
| | Inductive type network: this pictogram has the same position on the screen as the preceding pictogram. |
| | Generator network: there is no pictogram for a receiver network. Fixed Pictogram. |

# 8.3 Abbreviations

The *ENERIUM* display uses abbreviations of electrical symbols. These symbols, also used in the present document, are the following:

### 8.3.1 Units

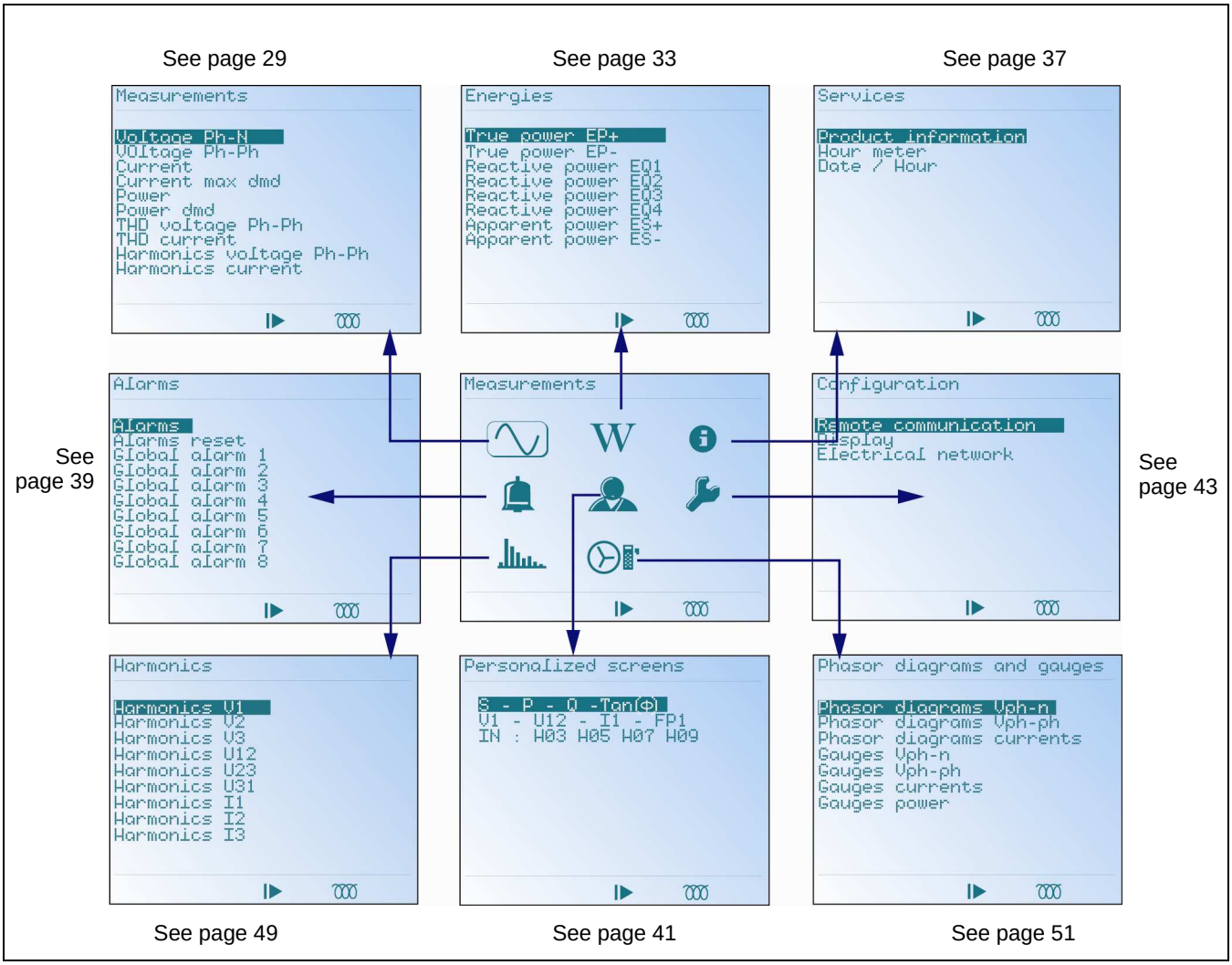
| Symbols | Description |
|---|---|
| % | Percent Symbol. |
| A | Real RMS current symbol in Ampere |
| V | Real RMS voltage symbol in Volt. |
| Hz | Network frequency. |
| VA | Apparent power (total if 3ϕ). |
| VAR | Reactive power (total if 3ϕ). |
| W | Active power (total if 3 ϕ). |
| kVAh | Total apparent energy in kilo. |
| MVAh | Total effective energy in mega. |
| kVARh | Total reactive energy in kilo. |
| MVARh | Total reactive energy in mega. |
| kWh | Total active energy in kilo. |
| MWh | Total active energy in mega. |

### 8.3.2 Electric variables

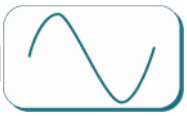
| Symbols | Description |
|---|---|
| F | Symbol for Frequency in Hertz. |
| FP | Power factor (ratio active / effective power). |
| Hxx Ia | Harmonic rate (%) of the 'xx' current range for the “a” conductor (a = 1, 2 or 3). |
| Hxx Uab | Harmonic rate (%) of ‘xx’ voltage range for the “ab” line phase (ab = 12, or 23 or 31). |
| Ix | Instantaneous current (A) of the “x” conductor (x = 1, 2, 3). |
| In | Neutral current (A) (value available only in a 4-wire networks). |
| Ix Max Moy | Maximum average current (A) (x = 1, 2, 3 or N) |
| P | Active power (W). |
| Pmoy | Active power (W) averaged over a defined duration Pmoy |
| Q | Reactive power (VAR). |
| S | Apparent power (VA). |
| Smoy | Effective power (VA) averaged over a defined duration. |
| THD Ix | Harmonic distortion rate (%) of the current in the “x” conductor (x = 1, 2 or 3). |
| THD Uab | Harmonic distortion rate (%) of the “ab” line phase (ab = 12, 23 or 31). |
| Uab | Real composed voltage (V) between the “ab” phase (ab = 12, or 23 or 31). |
| Vx | Ground voltage (V) between phase (x = 1, 2 ou 3) and neutral. |
| VT | Real RMS voltage (V) between neutral and earth. |

# 8.4 Synoptic of the menus

All the menus accessible from the main menu are shown hereafter with the reference to the related chapters.




*Flowchart of all the main menus accessible on ENERIUM.* SYOI

# 9. MEASUREMENTS (SCREEN 

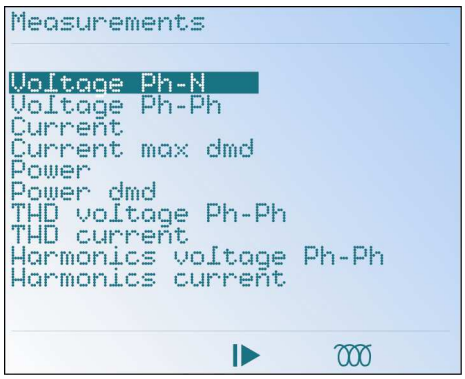
This screen displays the selection menu for the basic measurements (V, U, I, P, Q, S, PF, THD, H, etc.).

## 9.1 Access

This is achieved from the main menu by selecting the icon and pressing on the **OK** key.

## 9.2 ''Measurements'' screen

This screen looks as follows:




*The Measurements Screen.*

All the information displayed can be retrieved thru local or remote communication.

## 9.3 Information

This paragraph explains each screen accessible from the `Measurements` screen after pressing the **OK** key.

For each of the screens, navigation between the screens is done by pressing the keys ▲▼.

See paragraph 9.5.1 page 31 for the rules for value displays.

See paragraph 8.2.2 page 26 for the meaning of the icons at the bottom of the screen.

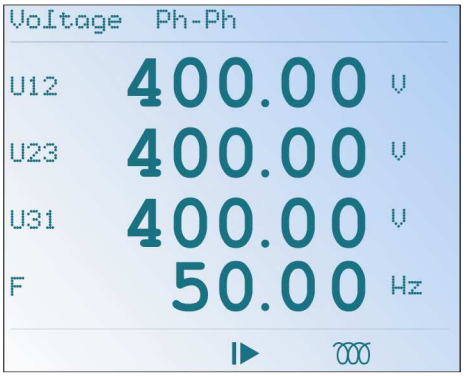
### 9.3.1 Ph-N Voltage

Display of each phase/neutral voltage difference; The VT value is the earth/neutral voltage difference.

*Example of the Ph-N Voltage screen* ME01A

### 9.3.2 Ph-Ph Voltage

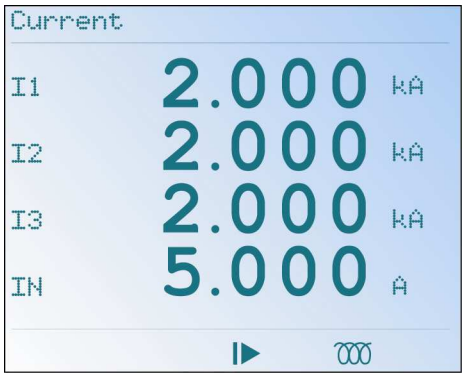
Display of the line voltage difference between phases ($U_{12}$, $U_{23}$, $U_{31}$) and frequency.




*Example of a Ph-Ph Voltage screen.*

### 9.3.3 Current

Display of the current of each line.




*Example of the Current screen.*

### 9.3.4 Maximum average current

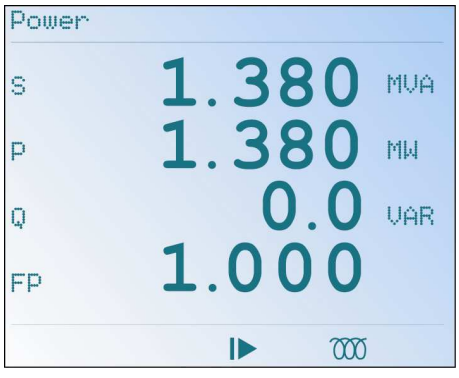
Display of the maximum average current of each line; the duration of integration is defined using a local or remote communication.

*Example of a Maximum Average Current screen*

See paragraph 25.19 page 91 for the calculation mode of the averages by *ENERIUM*.

### 9.3.5 Power

An example of display is shown below.




*Example of a Power screen*

Display of:

**S**: apparent power.

**P**: active power. This value can be negative if the load operates in a generator mode. The icon is then displayed at the bottom of the screen.

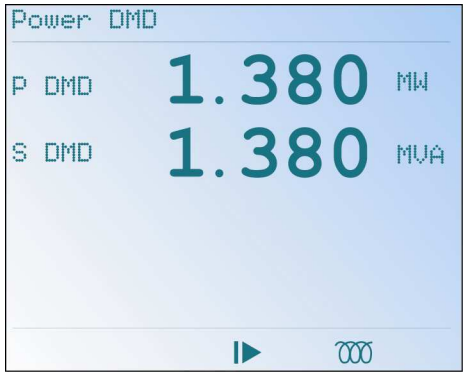
**Q**: reactive power. This value can be positive if the load is of inductive type. The icon is then displayed at the bottom of the screen. This value can be negative if the load is of capacitive type. The icon is then displayed at the bottom of the screen.

**FP**: power factor (ratio of the active / effective powers). This value can be negative if the load operates in generator. The icon is then displayed at the bottom of the screen.

Thru the and or icons , users know at anytime the quadrant in which the load works. Page 33 shows the quadrant positions.

### 9.3.6 Average power

Display of the active (P) and effective (S) average powers over duration. The duration is defined by a local or remote communication.



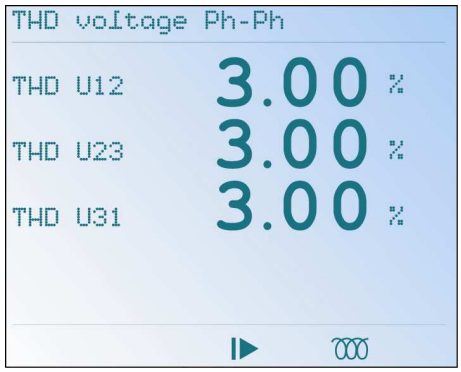

*Example of an Average Power screen*

See paragraph 25.19 page 91 for the calculation mode of the average by *ENERIUM*.

### 9.3.7 Ph-Ph Voltage THD

Display of the harmonic distortion rate on the three voltage lines.

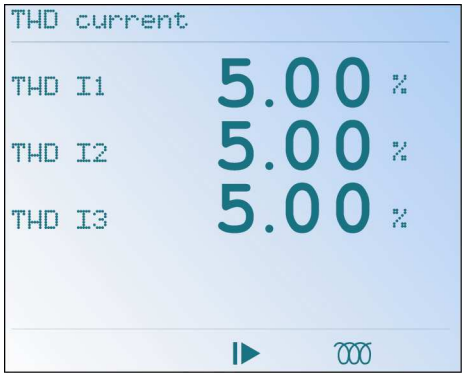
The *Harmonics* function displays graphics only for *ENERIUM 150* (see chapter 15 page 49).




*Example of a Ph-Ph Voltage THD screen.*

### 9.3.8 Current THD

Display of harmonic distortion rates on the three currents; the harmonic distortion rate of the neutral current is not measured and thus not displayed.



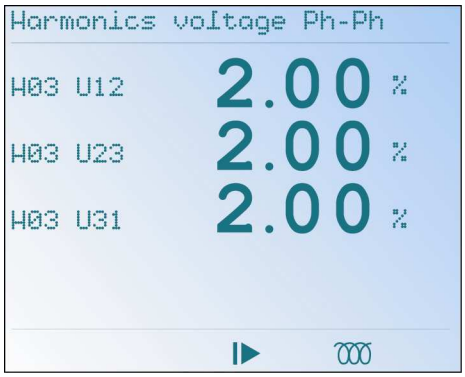

*Example of a Current THD screen*

The *Harmonics* function displays graphics only for *ENERIUM 150* (see chapter 15 page 49).

### 9.3.9 Ph-Ph Voltage Harmonics

Display of higher harmonic rates and of their ranges over the three line voltages. Each indication is read as follows (example):

- `H03 U12`: “range 3” harmonic rate of the U12 line voltage



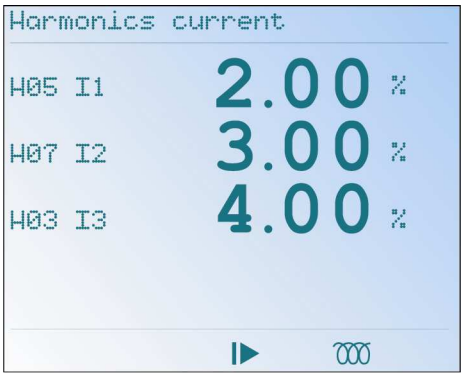

*Example of a Ph-Ph voltage Harmonics screen.*

The *Harmonics* function displays graphics only for *ENERIUM 150* (see chapter 15, page 49).

### 9.3.10 Current Harmonics

Display of higher harmonic factors and their ranges on the three currents. Each indication is read as follows (example):

- `H02 I1`: “range 2” harmonic factor of the current I1.




*Example of a Current Harmonics screen.*

The *Harmonics* function displays graphics only for *ENERIUM 150* (see chapter 15 page 49).

## 9.4 Return

Pressing on the ◀ key returns to the “Measurements’’ screen. Pressing twice on the ◀ key returns to the main screen (see paragraphs 8.2 page 25).

## 9.5 Notes

### 9.5.1 Display rule for voltages

Voltage displays (simple or composed) are made using four digits with one floating point. The following table shows the floating point position and the unit used for different measured values.

| V < | Display |
|---|---|
| 10 | 9,999 V |
| 100 | 99,99 V |
| 1 000 | 999,9 V |
| 10 000 | 9,999 kV |
| 100 000 | 99,99 kV |
| 1 000 000 | 999,9 kV |
| 10 000 000 | 9,999 MV |
| 100 000 000 | 99,99 MV |

### 9.5.2 Display rule for currents

Current displays are made using four digits with one floating point. The following table shows the floating point position and the unit used for different values measured.

| I < | Display |
|---|---|
| 10 | 9,999 A |
| 100 | 99,99 A |
| 1 000 | 999,9 A |
| 10 000 | 9,999 kA |

| | |
|---|---|
| 100 000 | 99,99 kA |
| 1 000 000 | 999,9 kA |
| 10 000 000 | 9,999 MA |
| 100 000 000 | 99,99 MA |

### 9.5.3 Display rule for frequency

Frequency displays are made using four digits with one floating point. As an example, frequency is displayed as 99.99 Hz.

### 9.5.4 Display rule for power

Power displays (active, reactive or effective) are made using four digits with one floating point. The following table shows the floating point position and the unit used for different values measured.

| P < | Display |
|---|---|
| 10 | 9,999 u |
| 100 | 99,99 u |
| 1 000 | 999,9 u |
| 10 000 | 9,999 ku |
| 100 000 | 99,99 ku |
| 1 000 000 | 999,9 ku |
| 10 000 000 | 9,999 Mu |
| 100 000 000 | 99,99 Mu |

For an active power, ‘‘u‘‘ means W. For a reactive power, ‘‘u‘‘ means VAR. For an effective power, ‘‘u‘‘ means VA.

### 9.5.5 Display rule for harmonics

Harmonic (of range x) or total harmonic distortion rate displays are made using four digits with one floating point. The point position is adjusted based on the value measured.

### 9.5.6 Display rule for the power factor

Power factor displays are made using three digits with one floating point (i.e. 9.99). A logo is used for the unit.

In case of an inductive power factor, the unit is the pictogram. In case of a capacitive power factor, the unit is the  pictogram.

### 9.5.7 Display rule for the time meter

Ttime meter displays are made using ten digits with one floating point and the unit is given. 99999999.99 h is an example.

# 10. ENERGIES (SCREEN)

This screen displays the menu for selection of active, reactive and effective energy measurements.

## 10.1 Access

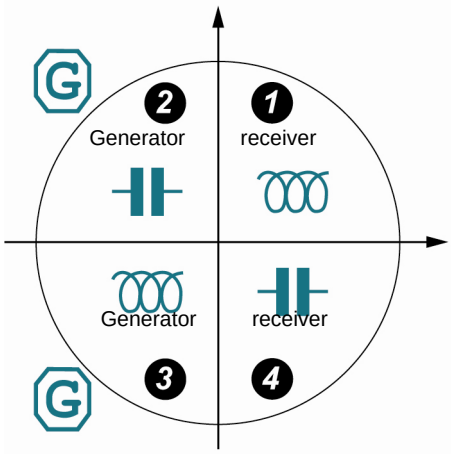
This is achieved from the main menu by selecting the icon W and pressing the **OK** key.

## 10.2 ''Energy'' Screen

This screen looks as follows:

*The Energy Screen.*

All the information displayed can be retrieved thru local or remote communication.




*Reminder of the quadrants used by ENERIUM.*

## 10.3 Information

This paragraph shows each of the screens accessible from the Energy screen by pressing the **OK** key.

For all the displays, scrolling between screens is done with the ▲▼ keys.

See paragraph 10.5.1 page 35, for the rules for value displays.

Also see paragraph 8.2.2 page 26 for the meaning of the icons at the bottom of the screen.

### 10.3.1 EP+ active Energy

Display of two active positive cumulated energy meters in receiver mode (quadrants 1 and 4) when powering up *ENERIUM.* The total value refers to a "two values" group: (see example):

MWh
**231**
kWh
**457.897**

indicates a metering of 231 457.897 kWh.

*Example of an EP+ active Energy Screen*

### 10.3.2 EP- active Energy

Display of two active negative cumulated and absolute energy meters in generator mode (quadrants 2 and 3) when powering up *ENERIUM*. The total value refers to a “two values” group: (see example):

MWh
**231**
kWh
**457.897**

Indicates a metering of 231 457.897 kWh.

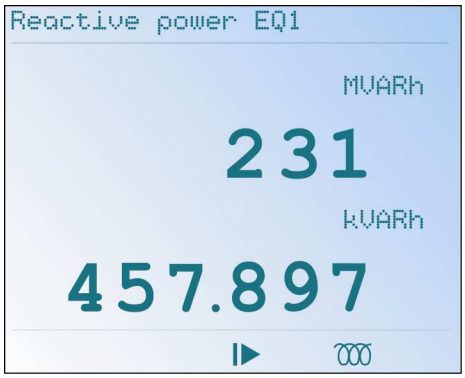
*Example of an EP- active energy screen*

### 10.3.3 EQ1 Reactive energy

Display of two positive reactive cumulated energy meters in receiver mode (quadrants 1) when powering up *ENERIUM*. The total value refers to a “two value” group: (see example):

MVARh
**231**
kVARh
**457.897**

Indicates the metering of 231 457.897 kVARh.




*Example of a EQ1 Reactive Energy screen.*

### 10.3.4 EQ2 Reactive energy

Display of two positive reactive cumulated energy meters in generator mode (quadrant 2) when powering up *ENERIUM*.

The data is read as indicated in paragraph 10.3.3.

### 10.3.5 EQ3 Reactive Energy

Display of two negative reactive cumulated energy meters in generator mode (quadrant 3) when powering up *ENERIUM*

The data is read as indicated in paragraph 10.3.3.

### 10.3.6 EQ4 Reactive energy

Display of two negative reactive cumulated energy meters in generator mode (quadrant 4) when powering up *ENERIUM*.

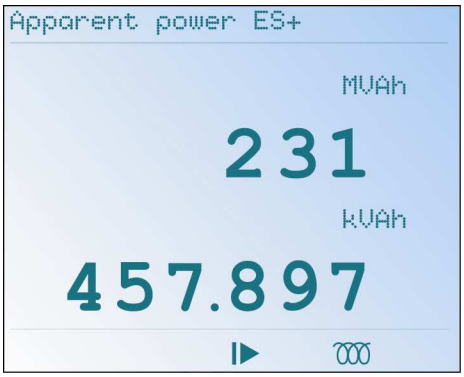
The data is read as indicated in paragraph 10.3.3.

### 10.3.7 ES+ Apparent Energy

Display of two apparent energy meters cumulated and absolute in receiver mode (quadrants 1 and 4) when powering up *ENERIUM*. The total value refers to a “two values” group: (see example):

MVAh
**231**
kVAh
**457.897**

Indicates a metering of 231 457.897 kVAh.




*Example of an ES+ Apparent Energy Screen*

### 10.3.8 ES- Apparent Energy

Display of two apparent cumulated and absolute energy meters in generator mode (quadrants 2 and 3) when powering up *ENERIUM*.

The data is read as indicated in paragraph 10.3.7.

## 10.4 Return

Pressing on the ◀ key returns to the “Measurements’’ screen. Pressing twice on the ◀ key returns to the main screen.

## 10.5 Notes

### 10.5.1 Display rules for energies

Energy meter display (active, reactive or apparent) is made on two lines.

On the first line, the upper part of the energy meter is displayed in the form 999999 Muh. On the second line, the lower part of the energy meter is displayed in the form 999.999 kuh. The letter “u” is defined as follows:

| Energy | Unit |
|---|---|
| Active | W |
| Reactive | VAR |
| Effective | VA |

# 11. SERVICES (SCREEN)

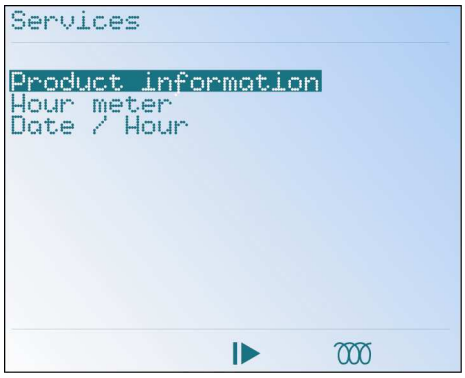
This screen shows the menu for selecting information relating to the device, time meters for the device's operating time and the internal timestamping.

## 11.1 Access

This is done from the main menu by selecting the icon and by pressing the **OK** key.

## 11.2 "Services" Screen

This screen is as follows:




*The Services Screen.*

All displayed information can be retrieved thru local or remote communication. No modification of the displayed values is possible.

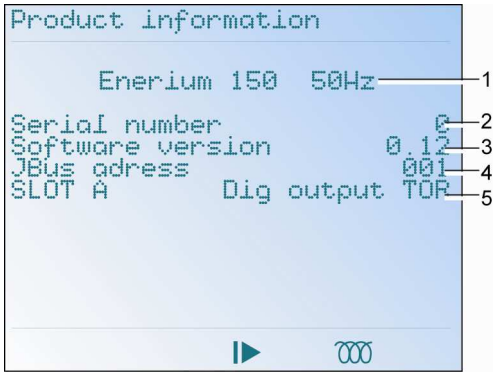
## 11.3 Information

This paragraph shows each of the screens accessible from the Services screen after pressing the **OK** key.

For all displays, the direct passage to the next or previous screen is possible with the ▼▲ keys.
See also paragraph 8.2.2, on page 26, for the meaning of the icons at the bottom of the screen.

### 11.3.1 Product Information

The following information is displayed:

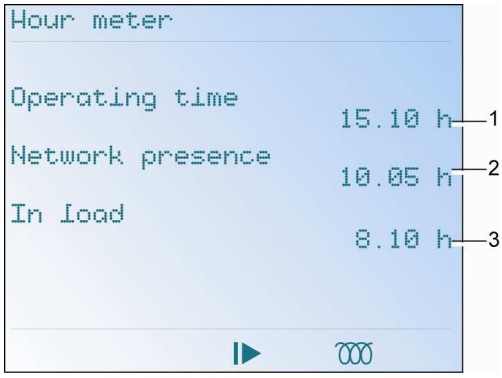



*Example of a Product information screen*

| Ref. | Indication |
|---|---|
| 1. | Type of *ENERIUM* (50, 150) and network frequency. |
| 2. | Serial number of *ENERIUM*. |
| 3. | Version number of the embedded software. |
| 4. | Indicates "Blank'' if no communication card is installed, else indicates the ModBus address for the option RS 485 or the IP address for the Ethernet options (see paragraph 14.3, in page 43 and in paragraph 14.4, in page 44). |
| 5 | Indicates "Blank'' if no input/output card is installed, else indicates the type of input/output card inserted (see paragraph 7.4, on page 20). |

### 11.3.2 Time meter

Three time meters are seen. The information, which can only be read, is displayed over ten digits, with fixed point as follows:

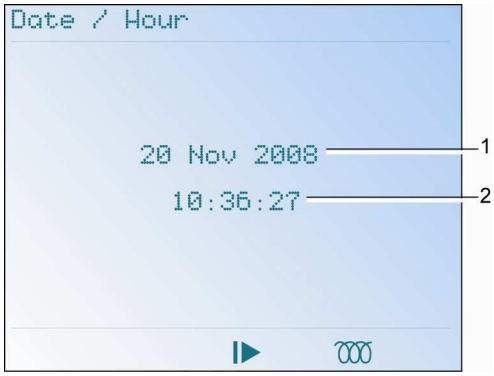



*Example of a Time meter Screen.*

| Ref. | Indication |
|---|---|
| 1. | **"Operating Time":** Time meter: duration of presence of the supply voltage (auxiliary source) on *ENERIUM* (see paragraph 7.3, on page 20). This indication is useful for the maintenance of *ENERIUM*. |
| 2. | **"Network Presence"** Time meter: duration during which, at least one ground voltage, from among V1[1s], V2[1s] and V3[1s] is different from zero. This indication is useful for the maintenance of the monitored load. |
| 3. | **"In Load"** Time meter: duration during which, at least one current, from among I1[1s], I2[1s] and I3[1s], is different from zero. This indication is useful for the maintenance of the monitored load. |

### 11.3.3 Date/Time

The following information, which ca only be read, is displayed:




*Example of a Date/Time Screen.*

| Ref. | Indication |
|---|---|
| 1. | Date |
| 2. | Time |

The date/time variable is recorded in the form of number of seconds elapsed since January 1st, 1970.

The display format of the date is "dd mmm yyyy", for all languages.

The date and time are modifiable only by local or remote communication.

## 11.4 Return

One press on the ◀ key enables the return to the “Services” screen. Two successive presses on the ◀ key return to the main screen.

# 12. (SCREEN) ALARMS

This screen shows the menu for selection of alarms (visualisation of the status of alarms and relays associated with On/Off outputs) and zero setting of possibly stored alarms.

## 12.1 Access

This is done from the main menu by selecting the icon and pressing on the **OK** key.

## 12.2 "Alarms'' Screen

This screen is as follows:

*The Alarms screen, on call.*

All displayed information can be retrieved thru local or remote communication.

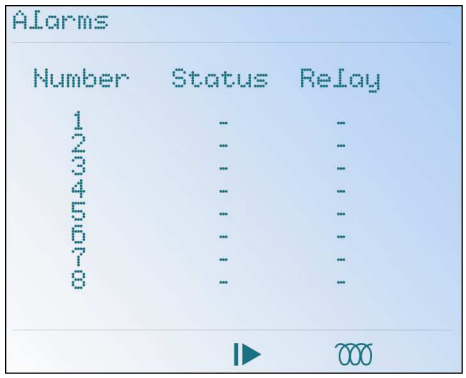
## 12.3 Information

This paragraph shows each of the screens accessible from the `Alarms` screen after pressing the **OK** key.

For each of the screens, the passage to the next or previous screens is done by pressing the keys ▲▼.
See also paragraph 8.2.2, on page 26, for the meaning of the icons at the bottom of the screen.

### 12.3.1 Alarms

The following information is displayed:




*Example of an Alarms screen.*

This screen shows, for each of the eight global alarms, the status of the active alarm, or having been activated in the first column, and the status of associated On/Off outputs (relays) (paragraph 7.4.2, on page 20) in the second column.

| Indication | Explanation |
|---|---|
| `Number` | Number of the global alarm (a global alarm is sometimes a combination of two elementary alarms). |
| `Status` | Status of the alarm (active or inactive) in the station.<br>- non-programmed alarm<br>○ non active programmed alarm.<br>● active programmed alarm. |
| `Relay` | Status of the associated relay (paragraph 7.4.2, in page 20).<br>- relay not associated with the alarm<br>○ relay associated with the alarm, but not active.<br>● relay associated with active alarm. |

The definition of alarms (number, NO/NF, delay time, threshold, measured variable) is only possible by local or remote communication (see chapter 22, page 73).

### 12.3.2 Resetting of Alarms

This screen enables the re-initialization of the alarms (release of the alarm of associated On/Off outputs) upon validation of the choice YES.

*Example of an Alarm resetting screen.*

To re-initialize the alarms, proceed as follows:

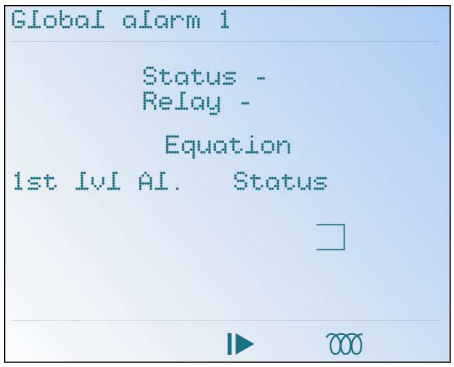
1. The Alarms Resetting screen is displayed.
2. Press on **OK** to enter the procedure.
3. Press on ▶ to highlight YES (black background).

   To quit this procedure without re-initializing the alarms, press on ◀ to highlight NO (black background).
4. Press on OK to validate the choice.
5. Return to the previous screen by pressing on ◀.

### 12.3.3 General Alarm (1 to 8)

Each of these eight screens displays the status, for each of the 8 global alarms (activated, deactivated) of this alarm, the associated load relay, the corresponding logic equation and elementary alarms.

A global alarm is activated by a combination of elementary alarms, combination defined from the *E.set* or *E.view* application (see the corresponding manual).




*Example of a Global alarm screen*

| Indication | Explanation |
|---|---|
| Status | Status of this global alarm (active or inactive) in the station.<br>- non-programmed alarm<br>○ non active programmed alarm.<br>● active programmed alarm. |
| Relay | Status of the relay associated with this general alarm.<br>- relay not associated with the alarm.<br>○ relay associated with the alarm, but not active.<br>● relay associated with the alarm and active. |
| El. Alarm | Name of the associated electrical variable, ex V1. |
| Status | Status of the elementary alarm output associated with this global alarm.<br>- output not associated with the alarm.<br>○ output associated with the alarm, but not active.<br>● output associated with the alarm and active. |
| Equation | Logic Equation AND or OR |

The activation of a general alarm is signaled locally by the blinking of the backlighting of the display area.

Thus, if a global alarm is activated, the *ENERIUM* screen will blink. The blinking is stopped after resetting (RAZ) of the status word for the alarms (command available under *E.set*, *E.view* or in the document *MSO-7388 – Mapping and command words*).

## 12.4 Return

One press on the ◀ key enables the return to the "Alarms'' screen. Two successive presses on the ◀ key return to the main screen.

# 13. CUSTOMIZED SCREENS

This screen shows the menu for selection of one of the three groups of screens defined using local or remote communication.

## 13.1 Access

From the main menu by selecting the icon and pressing on the **OK** key.

## 13.2 "Customized Screens'' Screen

Before any programming, the screen is as follows:

*The "Customized Screens" screen.*

## 13.3 Principle

Each of the three screens, basically named Title 1, Title 2 and Title3, can be freely configured by the user, using local or remote communication. Each of these three titles collects, in a screen specific to the user, a set of four measurements which the user wants to display simultaneously. All the combinations of data display are possible, from the variables measured by *ENERIUM* (see document *MSO-7388 – Mapping and command words*. Contact *ENERDIS* to obtain this document).

To view these three screens:

- Either **manually**, by access to this menu and selecting one of the three screens.
- Or **by programmed automatic scrolling,** of one, two or three of these screens.

  The *E.set* or *E.view* software ensures the parametering of these customisable screens.

## 13.4 Screens

This paragraph shows each screen accessible from the Customised Screens screen (after pressing the **OK** key, in their factory configuration.

*Example of a Customized Screen.*

Reminder: the **Title** name is defined by the *E.set* or *E.view* application (see this manual).

### 13.4.1 Title 1: "S-P-Q-Tan(ϕ) "

When not redefined by the user, this screen displays:

- Line 1: S three-phase.
- Line 2: P three-phase.
- Line 3: Q three-phase
- Line 4: Tan (ϕ).

### 13.4.2 Title 2: " V1-U12-I1-FP1 "

When not redefined by the user, this screen displays:

- Line 1: V1
- Line 2: U12
- Line 3: I1
- Line 4: FP1.

### 13.4.3 Title 3: " In: H03 H05 H07 H09 "

When not redefined by the user, this screen displays the harmonics of range 3, 5, 7 and 9 present on the neutral current In.

- Line 1: H03.
- Line 2: H05.
- Line 3: H07.
- Line 4: H09.

## 13.5 Return

One press on the ◀ key returns to the ''Customized Screens'' screen. Two successive presses on the ◀ key return to the main screen.

# 14. (SCREEN) CONFIGURATION

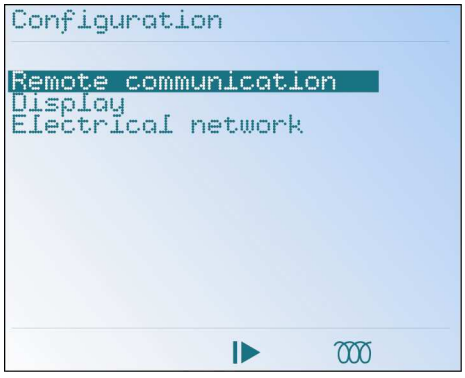
This screen shows the *Configuration* menu of *ENERIUM*.

## 14.1 Access

From the main menu by selecting the icon and pressing the **OK** key.

## 14.2 ''Configuration '' screen

The screen is as follows:




*Th Configuration screen.*

If a password has already been defined, this is necessary beforehand to access the `Configuration` screen. To do this, use the ▼▲ keys to modify the highlighted value (black background) and ◀▶ to change the position of the cursor. Press on **OK** to validate. If the password has been lost, the *E.set* software enables to retrieve it.

The password is defined as indicated in paragraph 14.5.5, on page 45). **The default password is 0000.**

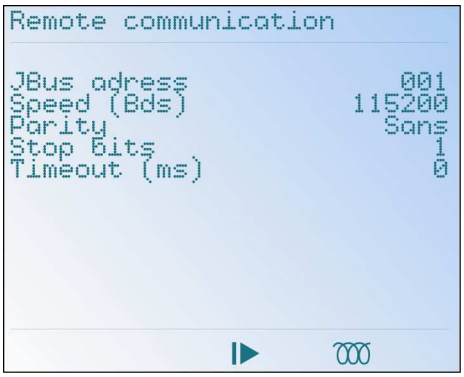
*A password can be requested before entry in the Configuration screen.*

## 14.3 Remote Communication RS 485

This information defines the characteristics of the RS485 remote communication (see paragraph 20.3, on page 65) between *ENERIUM* and the reading equipment.

Proceed as follows:

1. The `Configuration` screen is displayed.
2. Select the `Remote Communication` line with the ▲▼ keys and press on **OK** to display the `Remote Communication` screen.




*The RS485 Communication screen.*

### 14.3.1 JBus Address

1. When the Remote Communication screen is displayed, press **OK** to select JBus Address.
2. Press on **OK** to select the value (address) to be modified.
3. Use the ▼▲ keys to modify the highlighted value on the black background and ◀▶ to change the position of the cursor. The acceptable addresses range from 001 to 247, inclusive of the limits.
4. Press **OK** to validate.

### 14.3.2 Speed (Bauds)

1. Select the Speed(Bds) line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the value displayed (transmission speed in Bauds).
   The predefined values are 2400, 4800, 9600, 19200, 38400 and 115200.
3. Press on **OK** to validate.

### 14.3.3 Parity

1. Select the Parity line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the value displayed (parity). The predefined values are Without, Odd and Even.
3. Press on **OK** to validate.

### 14.3.4 Stop Bit

1. Select the Stop Bits line with the ▼▲keys and press on **OK**.
2. Use the ▼▲ keys to modify the value displayed (number of stop bits). The displayable values are 1 and 2.
3. Press on **OK** to validate.

### 14.3.5 Reversal (ms)

1. Select the Reversal (ms) line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the value displayed (reversal time in ms). The displayable values range from 0 to 500 by increments of 50.
   The reversal time, expressed in milliseconds, corresponds to the waiting time between the time when the RS485 frame has been received and the time when *ENERIUM* responds. This value is to be defined based on the number of *ENERIUM* connected on the RS485 line and the quality of the field bus.
3. Press on **OK** to validate.

### 14.3.6 Return

Press once on the ◀ key to return to the "Configuration'' menu.

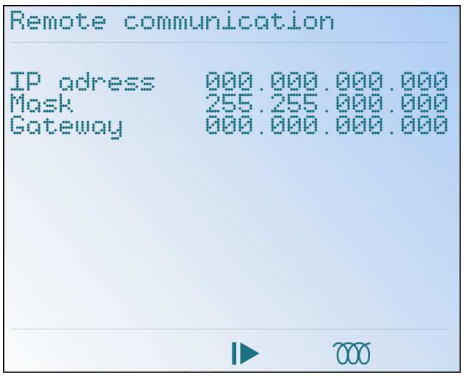
Press twice on the ◀ key to return to the main menu.

## 14.4 Remote Ethernet Communication

This information defines the Remote Ethernet communication characteristics (see paragraph 20.4, on page 66) between *ENERIUM* and the reading equipment.

Proceed as follows:

1. The Configuration screen is displayed.
2. Select the Remote Communication line with the ▼▲ keys and press on **OK** to display the Remote Communication screen.




*The Ethernet Communication Screen.*

### 14.4.1 IP Address

1. When the Remote Communication screen is displayed, press on **OK** to select the IP Address line.
2. Press on **OK** to select the value (address) to be modified.
3. Use the ▼▲ keys to modify the highlighted value on the black background and the ◀▶ keys to change the position of the cursor.
4. Press on **OK** to validate.

### 14.4.2 Mask

1. Select the Mask line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the value highlighted on the black background and the ◀▶ keys to change the position of the cursor.
3. Press on **OK** to validate.

### 14.4.3 Gateway

1. Select the `Gateway` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the value highlighted on the black background and the ◀▶ keys to change the position of the cursor.
3. Press on **OK** to validate.

### 14.4.4 Return

Press once on the ◀ key to return to the "Configuration'' menu.

Press twice on the ◀ key to return to the main menu.

## 14.5 Display

This information defines the following display characteristics:

- **Scrolling**: activation or deactivation of the scrolling for customized screens.
- **Time**: duration of display of each customized screen.
- **Language**: language for message display.
- **Contrast**: contrast level of the LCD display.
- **Password**: definition of a password to access the `Configuration` screen.

Proceed as follows for access to these sub-menus:

1. The `Configuration` screen is displayed.
2. Select the `Display` line with the ▼▲ keys and press on **OK** to display the `Display` screen.

*The Display screen.*

### 14.5.1 Scrolling

Activates or deactivates the possibility for scrolling of measurement screens as well as the possible display time; proceed as follows:

1. When the `Display` screen is displayed, press on OK to select `Scrolling`.
2. Press on **OK** to select the value to be modified.
3. Use the ▼▲ keys to modify the value displayed. The displayable values are `Yes` and `No`.

   **NO**: the display screens will not scroll. Only the manually selected screen will be continuously displayed.
   **YES**: the display screens, having been defined, by *E.view, E.set*, as the ones to be displayed one after the other, will be displayed cyclically at a periodicity defined by the value `Time` (see below). These screens will be predominant with respect to the normal display.

   All the visualization screens can be placed in this list, in any order and possibly several times.

   It is possible to automatically set the parameters for a maximum of 16 visualization screens. The list of screens to be scrolled is configurable using local or remote communication.

   Pressing any key enables to block the automatic scrolling mode and thus navigate with the keys in the different screens. If no key is pressed for 10 seconds and the automatic scrolling mode is always active, then the screens scroll again automatically one after the other.
4. Press on **OK** to validate.

### 14.5.2 Time (s)

Defines the display time for each selected screen. Proceed as follows:

1. Select the `Time (ms)` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the underlined value ◀▶ to change the position of the cursor.
   The acceptable values range from `01` to `10`.
3. Press on **OK** to validate.

### 14.5.3 Language

Defines the language for message display; Proceed as follows:

1. Select the `Language` line with the ▼▲ keys, for example.
2. Use the ▼▲ keys to modify the active language.

   The available languages are French, English, Spanish, German and Italian.
3. Press on **OK** to validate.

### 14.5.4 Contrast

Defines the contrast level of the LCD display; Proceed as follows:

1. Select the `Contrast` line and press on **OK**.
2. Use the ▼▲ keys to modify the contrast level. A **`0`** level corresponds to a pale screen (low contrast); a **7** level displays a darker screen (high contrast).
3. Press on **OK** to validate.

### 14.5.5 Password

If the password is different from "**0000"**, (parametering when received from the factory corresponding to a free

access), a password will be requested at the time of entry in the *Configuration* screen.

Proceed as follows:

1. Select the `Password` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the highlighted value (black background) and ◀▶ to change the position of the cursor.
   The range of acceptable codes is that of the ASCII table.

   If a code other than `0000` is activated, access to the `Configuration` screen will only be possible after request for this password.
3. Press on **OK** to validate.

The password is active only 30 seconds after its definition. Thus, after immediate return to the home screen from the *Configuration* menu, the latter can be redefined without request of the password if the 30 seconds have not yet not elapsed.

### 14.5.6 Return

It is essential to return to the main menu by successive presses on the ◀ key in order to quit the *Configuration* mode and prohibit the access to this mode if a password has been entered (paragraph 14.5.5, page 45).

No automatic return to the main menu is expected. However, if the power supply of the measure station is interrupted, the station restarts from the main menu and not as usual from the last screen displayed.

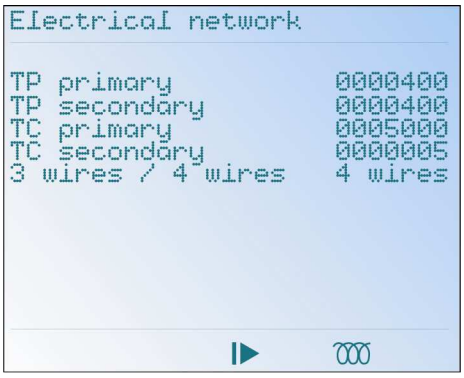
## 14.6 Electrical Network

This information defines the transformation ratios of voltage and current transformers used at the voltage and current entry terminals (see paragraph 20.2, on page 63).

Indeed, all the measurements being viewed from the primary side of the client transformers, the client transformer values are parametered in *ENERIUM*. The product of the CT primary by the PT primary should not be more than 693.0 MW (maximum three-phase power = $\sqrt{3}$ x 693 MW = 1.2 GW).).

Proceed as follows:

1. The `Configuration` screen is displayed.
2. Select the `Electrical network` line, and press on **OK** to display the `Electrical network` screen.




*The Electrical Network screen*

### 14.6.1 TP Primary

Defines the maximum voltage of the primary (line voltage) of the voltage transformer; Proceed as follows:

1. Display the `Electrical network` sceen and press on **OK** to select TP Primary.
2. Press on **OK** to select the value to be modified**.**
3. Use the ▼▲ keys to modify the value displayed and ◀▶ to change the position of the cursor.
   This value corresponds to the maximum operating voltage indicated on the primary of the voltage transformer.
   The primary (line voltage) of the TP transformer lies between 100 V and 650,000 V. The TP primary can be adjusted in increment of 1 V.
4. Press on **OK** to validate.

### 14.6.2 TP Secondary

Defines the maximum voltage of the secondary of the voltage transformer; Proceed as follows:

1. Select the `TP Secondary` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the underlined value and ◀▶ to change the position of the cursor.
   This value corresponds to the maximum operating voltage indicated on the secondary of the voltage transformer.
   The secondary (line voltage) of the TP transformer lies between 100 V and 480 V. The TP secondary can be adjusted in increments of 1 V.
3. Press on **OK** to validate.

### 14.6.3 TC Primary

Defines the maximum current of the primary of the current transformer; Proceed as follows:

1. Select the `TC Primary` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the underlined value and ◀▶ to change the position of the cursor.
   This value corresponds to the maximum working current indicated on the primary of the current transformer.
   The primary of the TC transformer lies between 1 A and 25,000 A. The TC primary can be adjusted in increments of 1 A.

3. Press on **OK** to validate.

### 14.6.4 TC Secondary

Defines the secondary current of the current transformer; Proceed as follows:

1. Select the `TC Secondary` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the underlined value.
   This value corresponds to the maximum working current indicated on the secondary of the current transformer.
   The secondary of the TC transformer lies between 1 A and 5 A. The TC secondary can be adjusted in inrements of 1 A.
3. Press on **OK** to validate.

### 14.6.5 3 wire / 4 wire

Defines the type of network to be monitored; Proceed as follows:

1. Select the `3 wire/4 wire` line with the ▼▲ keys and press on **OK**.
2. Use the ▼▲ keys to modify the selection displayed.
   **3 wire**: non-distributed neutral.
   **4 wire**: distributed neutral.
3. Press on **OK** to validate.

### 14.6.6 Return

Press on the ◀ key to return to the “Configuration” screen.

Press twice on the ◀ key to return to the main menu.

## 14.7 Default values

This table indicates the default values of the Configuration menu when the device is delivered.

| **RS 485 Communication (*)** | |
|---|---|
| Address | 001 |
| Speed | 9600 |
| Parity | Sans |
| Stop Bit | 1 |
| Reversal | 50 |

| **Ethernet Communication (*)** | |
|---|---|
| IP Address | 000.000.000.000 |
| Mask | 255.255.000.000 |
| Gateway | 000.000.000.000 |

*(*)RS 485 and Ethernet communications cannot be shown at the same time.*

| **Display** | |
|---|---|
| Scrolling | NO |
| Time | 03 |
| Language | Français |
| Contrast | 3 |
| Password | 0000 |

| **Electrical network** | |
|---|---|
| TP Primary | 400 |
| TP Secondary | 400 |
| TC Primary | 5000 |
| TC Secondary | 5 |
| 3 wire/4 wire | 4 wire |

## 14.8 Notes

If some parameters can be modified directly from the navigation keys of the display, others can only be defined using local or remote communication.

For local or remote communication, see chapter 22, on page 73.

The parameter setting by local or remote communication can be done using the *E.set* or *E.view* software. They enable the parameter setting (*E.set*) or remote parameter setting and visualization (*E.view*) using a digital connection (RS485, modem, optical, etc.).

Any other software or automaton compatible with the ModBus RTU standard enables the parameter setting of *ENERIUM*.

The reader can refer to the specific manual for this application.

It is accepted that *ENERIUM* is supplied (see paragraph 20.6, page 68) and connected to peripheral equipment (see chapter 20, page 63). However, the parameter setting can be performed without the peripheral equipment being connected.

For additional information on the MODBUS/RTU and MODBBUS/JCP/RTU protocol, contact *ENERDIS* to obtain the document *MSO-7388 – Mappings and command words*.

# 15. HARMONICS

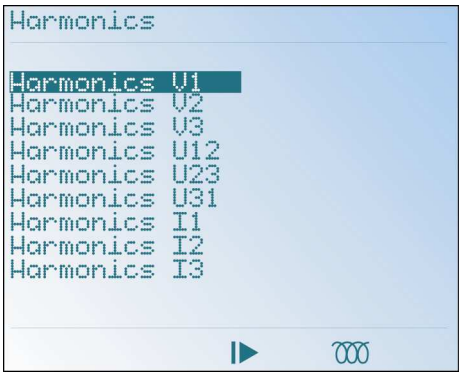
**This screen displays the menu of *Harmonics* only on *ENERIUM 150***. It enables the graphical visualization of harmonics, range by range, the three ground voltages, three line voltages, three currents and the corresponding distortion factors.

## 15.1 Access

From the main menu by selecting the icon and pressing the **OK** key.

## 15.2 ''Harmonics'' Screen

The screen is as follows:



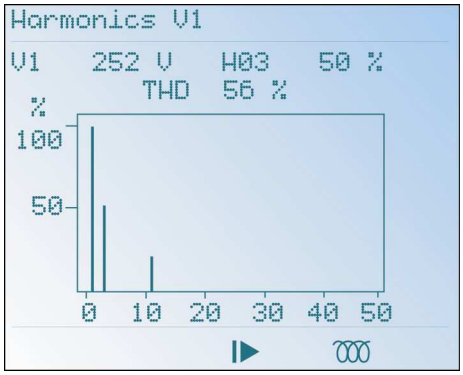

*Harmonics screen.*

It is used as follows:

1. The `Harmonics` screen is displayed.
2. Select the desired line with the ▼▲ keys and press on **OK** to display the corresponding screen. Refer to the next paragraphs for details.

### 15.2.1 V1 Harmonics

Press on the **OK** key to display the harmonics and the additional data on the ground voltage V1. The display is for example as follows:




*The V1 Harmonics Screens*

- The horizontal axis indicates the harmonic ranges from 1 to 50 for *ENERIUM* 150. Range 0 corresponds to the continuous component and ranges 1 to 50 correspond to harmonics.
- The vertical axis (0-100 %) indicates the harmonics ratio in percentage with respect to the basic (range 1).
- **V1**: instantaneous ground voltage in volts.
- **Hxx**: value in percentage related to the most important harmonic found between ranges 1 and 50.
- **THD**: total harmonic distortion (see formula used in paragraph 25.14, on page 89.

### 15.2.2 V2 Harmonics

Displays the harmonics and additional data on ground voltage V2. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.3 V3 Harmonics

Displays the harmonics and additional data on the ground voltage V3. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.4 U12 Harmonics

Displays the harmonics and additional data on the line voltage U12. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.5 U23 Harmonics

Displays the harmonics and additional data on the line voltage U23. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.6 U31 Harmonics

Displays the harmonics and additional data on the line voltage U31. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.7 I1 Harmonics

Displays the harmonics and additional data on the current I1. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.8 I2 Harmonics

Displays the harmonics and additional data on the current I2. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

### 15.2.9 I3 Harmonics

Displays the harmonics and additional data on the current I3. Refer to paragraph *15.2.1 - V1 Harmonics*, on page 49 for details.

## 15.3 Return

Press twice on the ◀ key to return to the main menu.

# 16. FRESNEL AND GAUGE

**This screen displays the *Fresnel and gauges* menu on an *ENERIUM 15* only.** It enables the graphic visualization of:

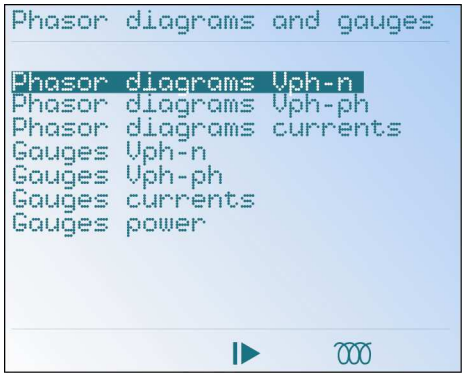
- Three ground and line voltages, and currents in the form of a Fresnel diagram.
- Three ground and line voltages, currents and powers (P1, P2, P3) in the form of baragraphs.

## 16.1 Access

From the main menu by selecting the icon and pressing the **OK** key.

## 16.2 "Fresnel and gauges'' Screen

The screen is as follows:



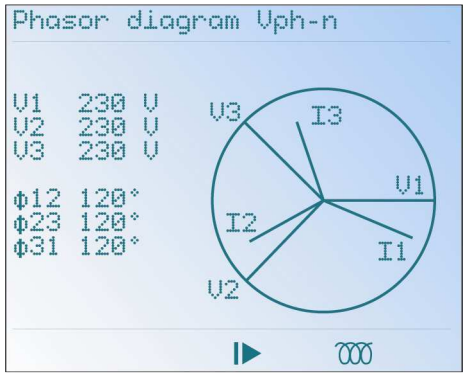

*The Fresnel and gauge screen.*

It is used as follows:

1. The `Fresnel and gauges` screen is displayed.
2. Select the desired line with the ▼▲ keys and press on **OK** to display the corresponding screen. Refer to the next paragraphs for details.

### 16.2.1 3V Fresnel

Press on the **OK** key to display the Fresnel diagram of the three ground voltages and the additional data. The display is as follows:




*Example of a 3V Fresnel diagram*

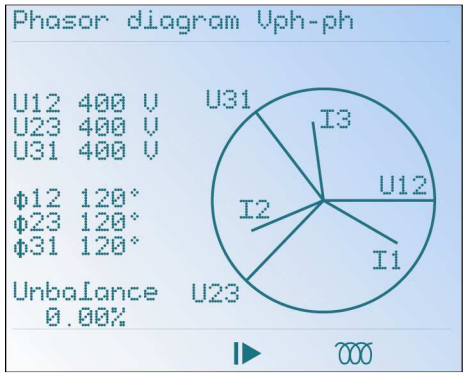
The information is the following:

- **V1**: instantaneous ground voltage V1 in volts.
- **V2**: instantaneous ground voltage V2 in volts.
- **V3**: instantaneous ground voltage V3 in volts.
- **Φ12**: phase shift, in degrees, of the V1 ground voltage with regard to the V2 ground voltage.
- **Φ23**: phase shift, in degrees, of the V2 ground voltage with regard to the V3 ground voltage.
- **Φ31**: phase shift, in degrees, of the V3 ground voltage with regard to the V1 ground voltage.

Press on the key ◀ to return to the previous screen.

### 16.2.2 3U Fresnel

Press on the **OK** key to display the Fresnel diagram of the three ground voltages and the additional data. The display is as follows:




*Example of a 3U Fresnel diagram.*

The information is the following:

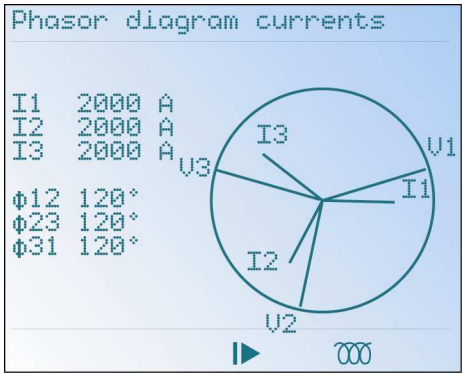
- **U12**: instantaneous line voltage U12 in volts.
- **U23**: instantaneous line voltage U23 in volts.
- **U31**: instantaneous line voltage U31 in volts.
- **Φ12**: phase shift, in degrees, of the U12 line voltage with regard to the U23 line voltage.
- **Φ23**: phase shift, in degrees, of the U23 line voltage with regard to the U31 line voltage.
- **Φ31**: phase shift, in degrees, of the U31 line voltage with regard to the U12 line voltage.

The **`Disequilibrium`** indication shows the rate of unbalance between the line voltages. A correctly balanced network has a rate close to zero.

Press on the ◀ key to return to the previous screen.

### 16.2.3 3I Fresnel

Press on the **OK** key to display the Fresnel diagram of the three currents and the additional data. The display is as follows:




*Example of a 3I Fresnel diagram.*

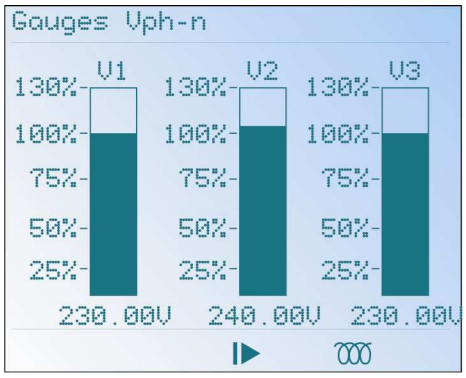
The information is the following:

- **I1**: instantaneous current I1 in amperes.
- **I2**: instantaneous current I2 in amperes.
- **I3**: instantaneous current I3 in amperes.
- **Φ12**: phase shift, in degrees, of the ground current I1 with regard to the current I2.
- **Φ23**: phase shift, in degrees of the ground current I2 with regard to the current I3.
- **Φ31**: phase shift, in degrees, of the ground current I3 with regard to the current I1.

Press the key ◀ to return to the previous screen.

### 16.2.4 3V Gauges

Press on the **OK** key to display the baragraph of the three ground voltages. The display is as follows:




*Example of a 3V baragraph*

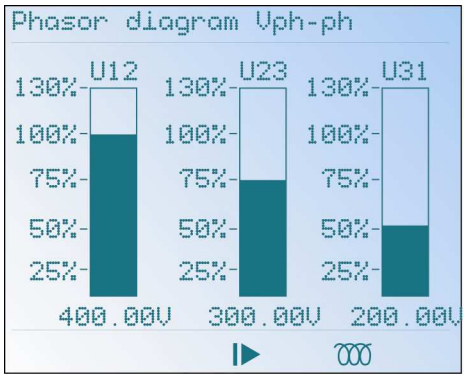
The indication “0 - 130 %” of the baragraph indicates the instantaneous value measured with regard to the TP primary value programmed in `Configuration/Electrical network`.

For example, for a TP primary programmed for 400 V, 100% of the gauge corresponds to $400 V / \sqrt{3}$.

Press on the key ◀ to return to the previous screen.

### 16.2.5 3U Gauges

Press on the **OK** key to display the baragraph diagram of the three line voltages. The display is as follows:



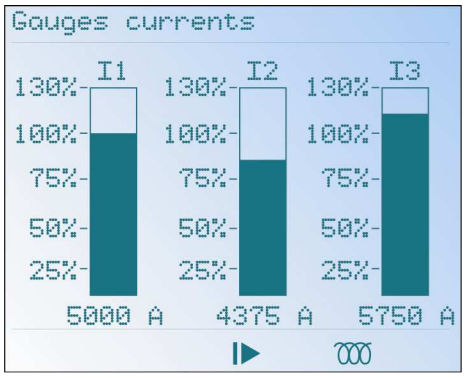

*Example of a 3U baragraph.*

The indication “0 - 130 %” of the baragraph indicates the instantaneous value measured with regard to the TP primary value programmed in `Configuration/Electrical network`.

For example, for a TP primary programmed for 400 V, 100% of the gauge corresponds to 400 V.

### 16.2.6 3I Gauges

Press on the **OK** key to display the baragraph diagram of the three currents. The display is as follows:



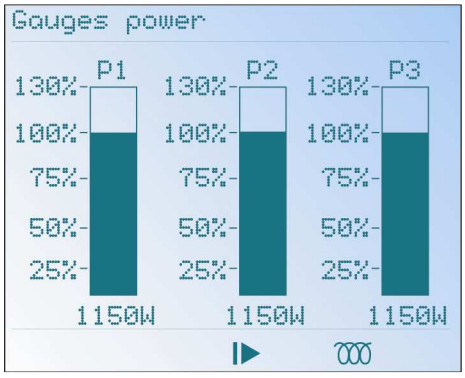

*Example of a 3I baragraph.*

The indication “0-130 %” of the baragraph indicates the instantaneous value measured with regard to the TC primary value programmed in *Configuration/Electrical network*.

For example, for a TC primary programmed for 5000 A, 100 % corresponds to 5000 A.

### 16.2.7 3P Gauges

Press on the **OK** key to display the baragraph diagram of the three active powers. The display is as follows:




*Example of a 3P baragraph.*

The indication “0-130 %” of the baragraph indicates the instantaneous value measured with regard to the TC and TO primary values programmed in *Configuration/Electrical network*.

For example, for a TC primary programmed for 5000 A and a TP primary programmed for 400 V, 100 % corresponds to $\frac{5000 * 400}{\sqrt{3}}$, which is 1 154.7 kW.

## 16.3 Return

Press the ◀ key twice to return to the main menu.

# 17. LOAD CURVES

This curve cannot be displayed on the *ENERIUM* screen but when using a specific application (*E.view* or any application developed by the user).

The station can activate or not a recording of a load curve. This load curve records from one to eight variables among the following ten variables P+, P-, Q1, Q2, Q3, Q4, S+, S-, TOR1, TOR2. The integration time of these variables can be parametered among the times 5, 10, 12, 15, 20, 30 and 60 minutes.

Each recording is composed of a time stamping (date and time), a status and selected variables (maximum eight). The variables are always ranked in the following order: P+, P-, S+, S-, Q1, Q4, Q2, Q3, TOR1 and TOR2.

The recording depth is based only on the parametered integration time. The number of selected variables does not modify the recording depth.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tps (1) | 5 | 10 | 12 | 15 | 20 | 30 | 60 |
| Pfd (2) | 17 | 34 | 40 | 51 | 68 | 102 | 204 |

*(1): Integration time in minutes*
*(2): Recording depth in days.*

The *E.set* and *E.view* software automatically provide the recording depth according to the selected integration time.

The status contains the marking of following events: synchro loss, synchro return and change of configuration and mains supply cut.

It is possible to reinitialize the load curves in totality by sending a command word by local or remote communication. A material entry is allocated to one of the variables On/Off1 to 2, by the sending of a command word over the local or remote communication.

For additional information, contact *ENERDIS* to obtain:

- the MSO-7389 document for the management of load curves.
- the MSO-7388 document for the mapping and command words.

# 18. RECORDING CURVES

**This function is only available on *ENERIUM 150***.

These curves cannot be displayed on the *ENERIUM* screen, but by using a specific application (*E.view* or any other application developed by the user).

The product can record till four recording curves. The recording period can be different from one curve to another. This recording period is chosen, for each curve, between 1 and 59 seconds in increments of one second or among the following predefined values: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 minutes.

The recording depth is only based on the recording period. The system is designed to save a maximum of 4032 values.

E.g.: for a recording period parametered at 1 second, the storage register will be full at the end of 4032 seconds, or 1 hour, 7 minutes and 12 seconds.

According to the recording periods allowed from 1 second to 60 minutes, the recording period ranges from 1 hour, 7 minutes and 12 seconds to 168 days.

The *E_Set* and *E_View* software automatically provide the recording depth according to the selected recording period.

## 18.1 Recorded variables

The following measurements can thus be recorded in a recording curve:

- Average ground voltages
- Average line voltages
- Average currents
- Currents per second
- Three-phase active power per second
- Three-phase apparent power per second
- Three-phase reactive power per second
- Global power factor per second
- Unbalance factor per second
- Average active powers over each phase and three-phased in generator and receiver mode.
- Average power factors over each phase and global in generator and receiver mode
- Average Cos(φ) over each phase and global in generator and receiver mode.
- Average three-phase TAN(φ)s in generator and receiver mode.
- Average frequency
- Average peak factors
- Average THDs in ground voltage, line voltage and in current of each phase

## 18.2 Synchronization modes

There are three types of synchronizations to manage the launch or stop of the recordings of previously selected electrical variables:

- for the first type called "**Synchronization on date**", the recording of data starts or stops when *ENERIUM* reaches the programmed date and time.
- For the second type called "**Synchronisation on On/Off input**", the recording of data starts or stops when the selected On/Off input changes status.
- for the third type called "**Synchronisation on alarm**", the recording of data starts or stops when the selected global alarm is activated. s

## 18.3 Operating modes of recording curves

There are five operating modes of recording curves:

- **Continuous Mode**: the recordings are done in a circular manner in the curve, the oldest recording being deleted by the latest recording (FIFO type curve). In this mode, the three types of synchronization are authorised for the recording launch. On the other hand, only the writing of a command word on the local or remote communication can stop the data recording.
- **Mode with stop on full buffer**: the three types of synchronisation are authorised for the launch of the recording. The recording is stopped when the storage register is full.
- **Mode with immediate stop on synchro**: the recordings are done also in a circular manner in the curve, the oldest recording being deleted by the latest recording (FIFO type curve). The recording

starts as soon as a variable is allotted to the curve. The writing of a command word on the local or remote communication, a "Synchro on On/Off input" or even a "Synchro on alarm" can immediately stop the data recording.

- **Mode with stop on centered synchro 25%-75%**: the recordings are done in the same manner as in the third mode. But the recording stop occurs only when 75 % of the recording curve contains data recorded after the stop command, which can be the writing of a command word on the local or remote communication, a "Synchro on On/Off input" or even a "Synchro on alarm".
- **Mode with stop on centered synchro 50%-50%**: the recordings are done in the same manner as in the third mode. But the recording stop occurs only when 50 % of the recording curve contains data recorded after the stop command, which can be the writing of a command word on the local or remote communication, a "Synchro on On/Off input" or even a "Synchro on alarm".

## 18.4 Indicators of the recording curve

***Status of the recording curve***

This indicator gives the status of the recording curve. The status is:

- "**Non-programmed**" if the curve is not programmed, i.e. if the variable allocated to the curve is “none’’.
- "**Pending**" if a curve is programmed and waiting for the start synchro.
- "**In progress**" if the curve records values periodically.
- "**Terminated**" if a stop command came or if the curve stopped by itself.

***Filling rate of the curve***

This indicator gives the filling rate of the curve. For curves managed in FIFO mode, this rate remains blocked at 100%, when the recordings crash the oldest ones.

When programming a new recording curve, this automatically entails the stop and reset of the curve previously ongoing recording or recorded. The resetting of a trend curve can be launched manually, by writing a command word on the local or remote communication.

All the programmed curves recover their recordings after a break of the auxiliary source, without performing any marking.

It is possible to immediately stop the recording of a curve by sending a command word on the local or remote communication.

The time setting of the product entails no change in the programming. Moreover, no marking is executed in the curves in case of change of time.

For more information, contact ENERDIS to obtain the MSO-7390 document on recording curves and the MSO-7388 document on the mapping and command words.

# Installation

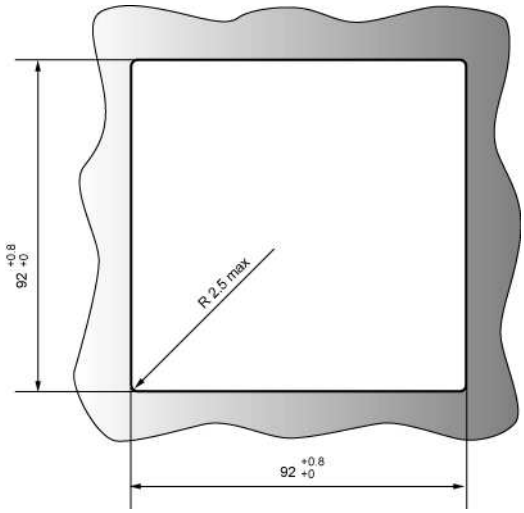
# 19. MECHANICAL ASSEMBLY

This chapter describes the mechanical assembly of *ENERIUM*. The dimensions are found in paragraph 24.9, on page 84.

## 19.1 Cutting

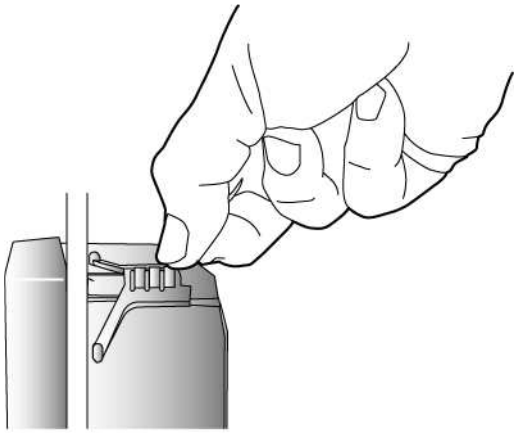
Assembling this version is done exclusively on panel. Proceed as follows:

1. Make a cutting as indicated in the following figure.




*Dimensions of the cutting of the panel*

2. Insert *ENERIUM* in the cutting, thru the external part.
3. Slide the two table fasteners and push them until you find the correct positioning of *ENERIUM*.



*Setting up a panel fastener: pull the clip end and slid it as indicated above.*

## Operations: Continuation

This consists of the electrical assembly of the *ENERIUM* and its additional elements (voltage transformers, current transformers, etc.).

# 20. ELECTRICAL CONNECTION

This chapter describes the electrical assembly of *ENERIUM*.

## 20.1 Preliminary notes

### 20.1.1 Safety precautions

Before proceeding with the electrical installation of the equipment and its peripheral elements, check that the power supply is disconnected and locked in compliance with good engineering practices and safety rules.

### 20.1.2 Maximum applicable values

Refer to *Chapter 24 – Technical characteristics,* on page *79*.

It is to be noted that any overshooting of the maximum applicable values can cause a permanent deterioration of the device.

### 20.1.3 Protection of the U and I inputs

The insertion of fuses on the voltage inputs as well a short circuit system for the current inputs is strongly recommended.

### 20.1.4 Cables and terminals

The connections are made on:

- screw terminals which can be dismantled for 2.5 mm² cables for the optional cards and the RS485 remote communication.
- fixed screw terminals for the 2.5 mm² cables for the power supply of the station and the voltage measurement inputs.
- fixed screw terminals for the rigid or flexible wires of 6 mm² section for the current measurement inputs.

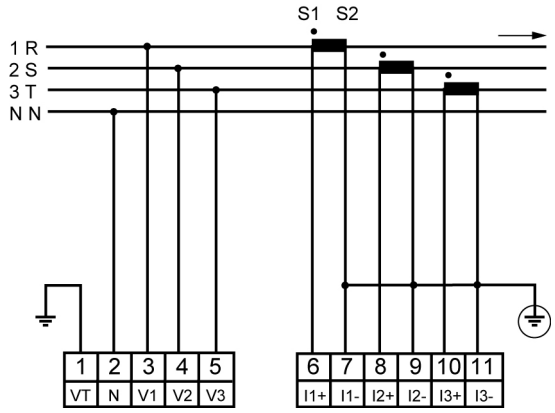
### 20.1.5 Precautions against electrical parasites

Although *ENERIUM* is immuned against electrical current disturbances, it is desirable to avoid immediate proximity of parts generating strong electrical parasites (high power contactors, bus bar, etc.). The quality of the communication on the computer bus depends a lot on respecting these precautions.

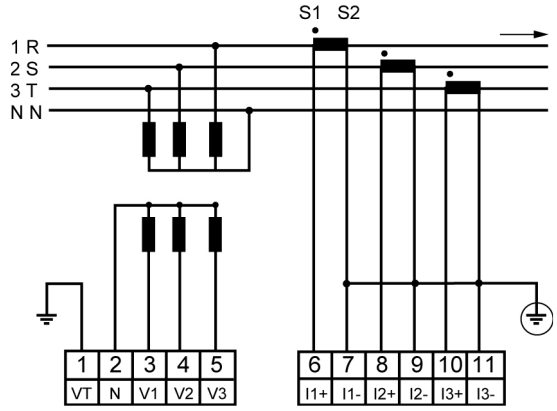
## 20.2 Connection of voltage and current inputs

The voltage and current inputs will be connected based on the type of assembly selected. See paragraph 7.2 on page 19, for the terminal localization and the technical details. The abbreviations are as follows:

### 20.2.1 Unbalanced three-phase, 4 wires - 3 TC

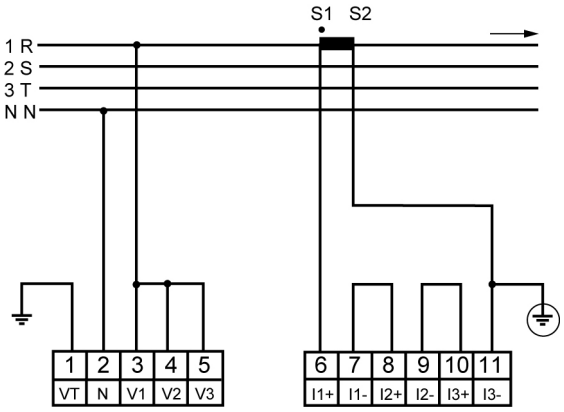



*Assembly without TP.*

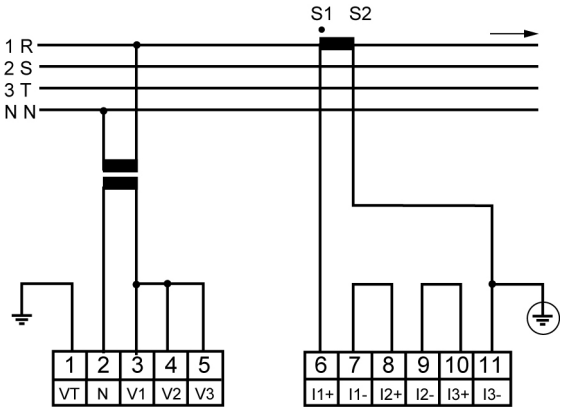



*Assembly with TP in star.*

### 20.2.2 Balanced three-phase, 4 wires - 1 TC

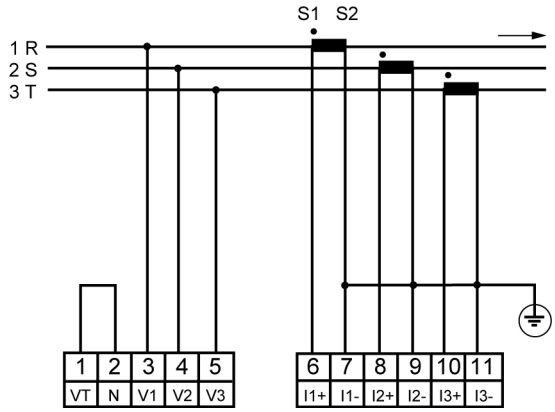



*Assembly without TP.*

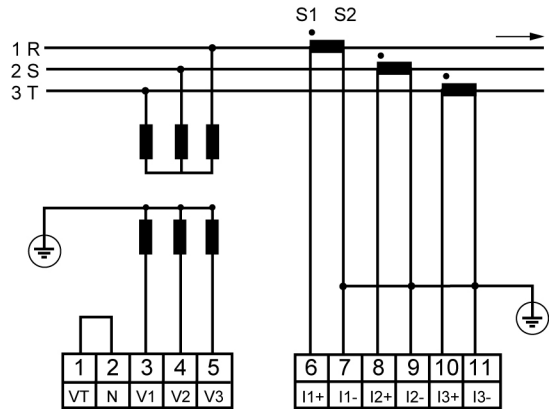



*Assembly with TP.*

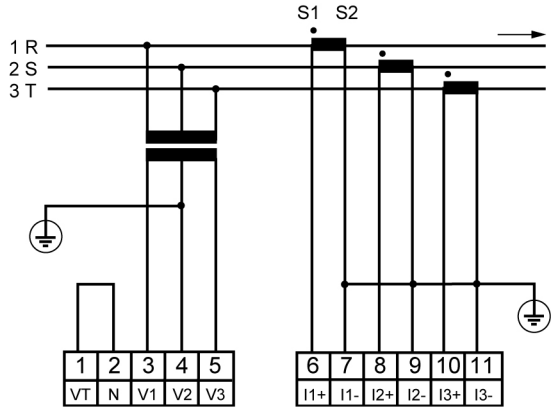
### 20.2.3 Unbalanced three-phase, 3 wires - 3 TC




*Assembly without TP.*

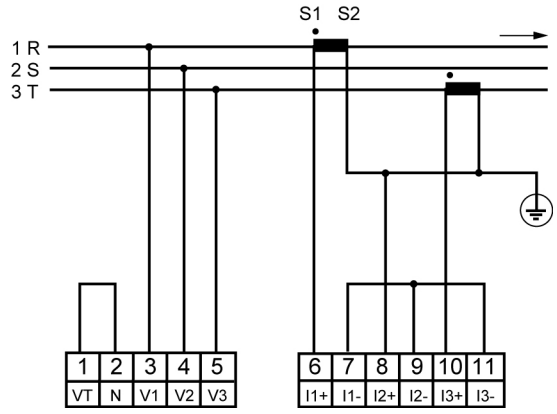



*Assembly with TP in star shape.*

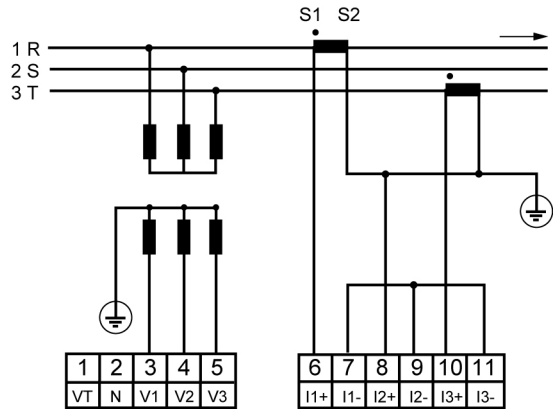



*Assembly with TP in triangle shape.*

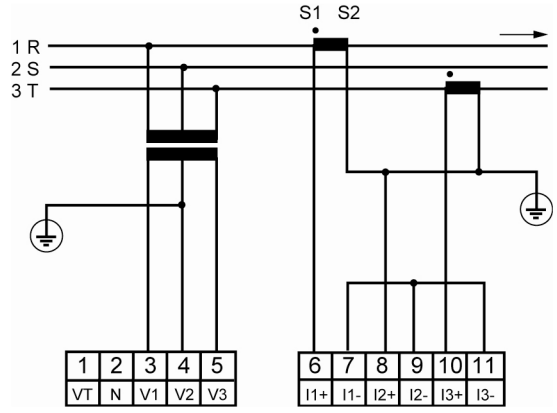
### 20.2.4 Unbalanced three-phase, 3 wires - 2 TC




*Assembly without TP.*

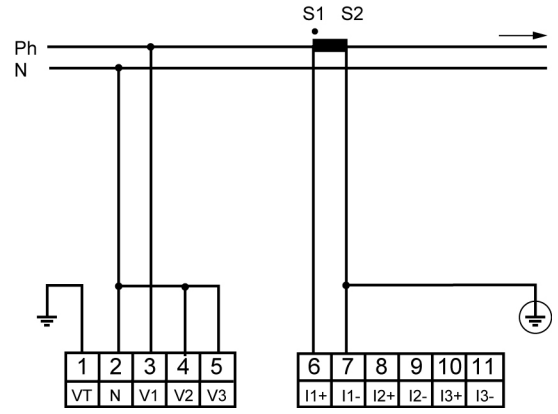



*Assembly with TP in star shape.*

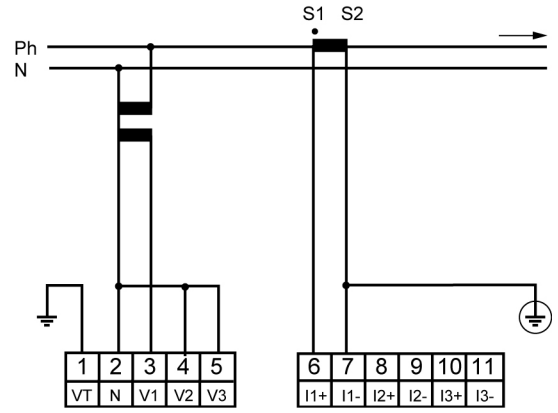



*Assembly with TP in triangle shape.*

### 20.2.5 Mono-phase assembly




*Assembly without TP.*




*Assembly without TP.*

## 20.3 RS485 Connection

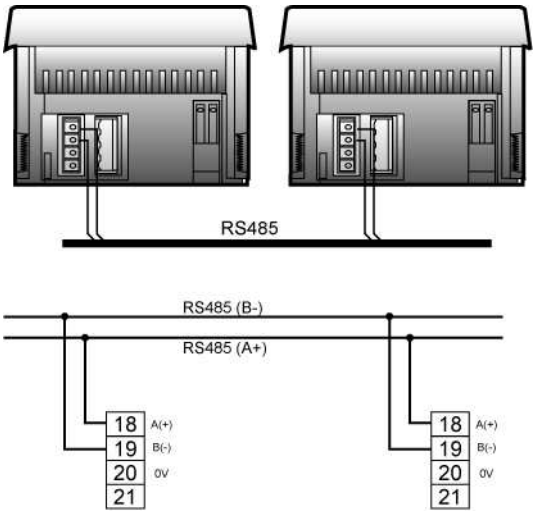
*The RS485* output cannot be present when the *Ethernet* card is present.

Only tests on the actual network can validate the best combination (speed, network length, impedance adaptation, etc.).

See paragraph 7.5, on page 21 for the location of the terminal and the technical details.

### 20.3.1 In undisturbed environment

For an RS485 network in undisturbed electrical environment, if possible use a twisted-pair cable. This cable will be connected to the 18 (A+) and 19 (B-) terminals. The agreement adopted for terminals (A) and (B) corresponds to the EI485 standard (§ 3.2) specifying that a logic level '"1" on the line corresponds to VB>VA and a logic level "0" corresponds to VA>VB.

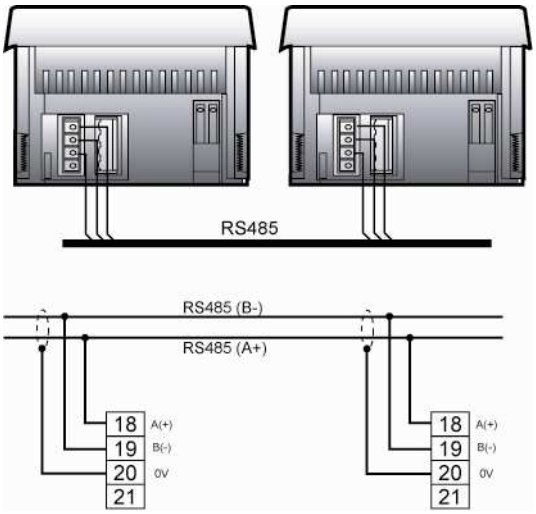



*Connection of the RS485 link (standard connection).*

### 20.3.2 In disturbed environment

***With shielding***

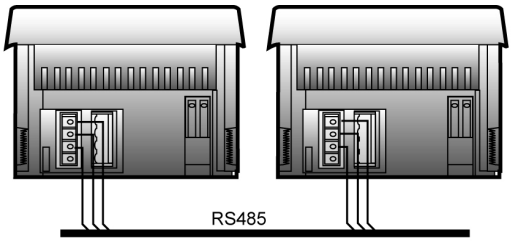
In case of a particularly disturbed electrical environment, a shielded twisted-pair cable must be used and the shielding of this cable must be connected to the terminal 0 V (20) of *ENERIUM*.

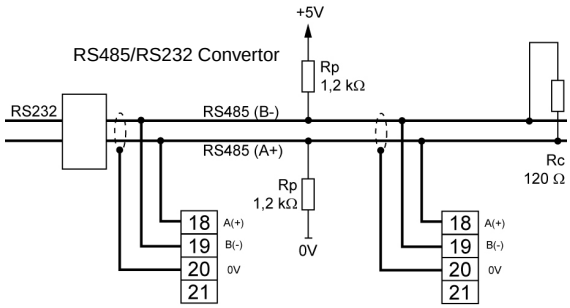



*Connection of the RS485 link in disturbed electrical environment (presence of a shielding)*

***With shielding and resistances (polarization and load))***

In order to improve the quality of transmission in disturbed environment, it is also possible to polarize the line in a single point. This polarization imposes the rest level in the absence of transmission by two resistances of 1.2 kΩ, between the 0 V line and the 5 V line. These resistances are sometimes included in the RS485/RS232 convertors. It is sometimes necessary to adapt the line by connecting a resistance of 120 Ω to the two ends of the bus.



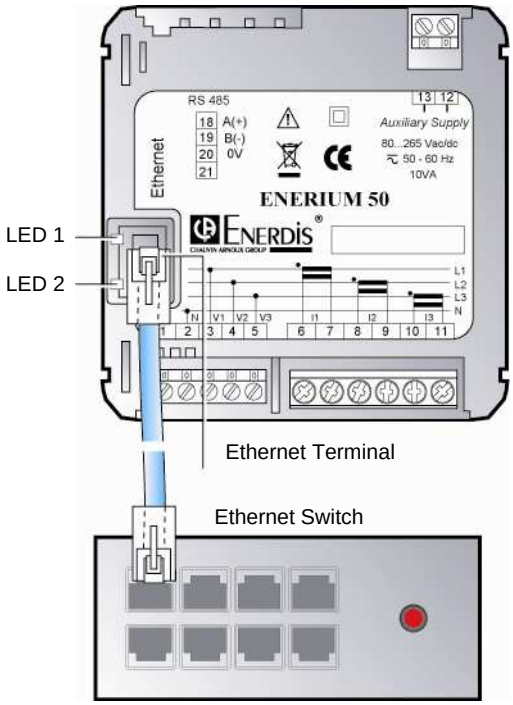

*Connection of the RS485 link in disturbed electrical environment with load and polarization resistances*

## 20.4 *Ethernet* Connection

The *Ethernet* output cannot be present when the RS485 card is present.

Connect the *RJ45 Ethernet* plug of each *ENERIUM* to an RJ45 inlet of a switch (or hub) using an Ethernet cable (straight cable for connection to a switch, twisted cable for the connection to a PC).

See paragraph 7.6, en page 22 for the location of the terminal and the technical details.




*Connection of the Ethernet link to a switch.*

### 20.4.1 LED 1: Connection LED

| Colour | Meaning |
|---|---|
| Off | No connection. |
| Orange | Connection at 10 Mb per second. |
| Green | Connection at 100 Mb per second. |

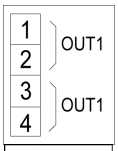
### 20.4.2 LED 2: Activity LED

| Colour | Meaning |
|---|---|
| Off | No activity |
| Orange | Half duplex. |
| Green | Full duplex. |

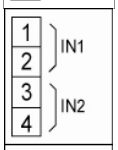
## 20.5 Connection of input and output cards

These cards are optional.

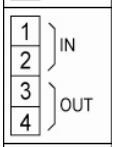
The following figures show the labels associated with different optional cards.



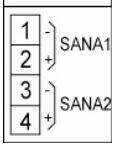

2 On/Off outputs option card label




2 On/Off inputs option card label




1 On/Off input and 1 On/Off output option card label




2 analog outputs option card label

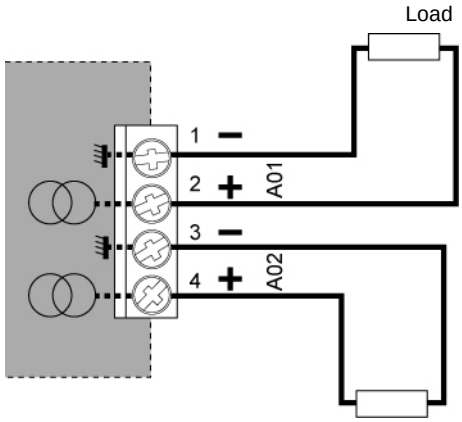
### 20.5.1 2 output analog card

It is essential to parameter this card using local or remote communication.

See paragraph 7.4.1, on page 20 for the technical details regarding these analog outputs.

Connect the load and the connecting cable as follows:

| Card output | Terminal | Function |
|---|---|---|
| A01 | 1 | A01 analog output cold point. |
| A01 | 2 | A01 analog output hot point. |
| A02 | 3 | A02 analog output cold point. |
| A02 | 4 | A02 analog output hot point. |




*Connection of analog outputs.*

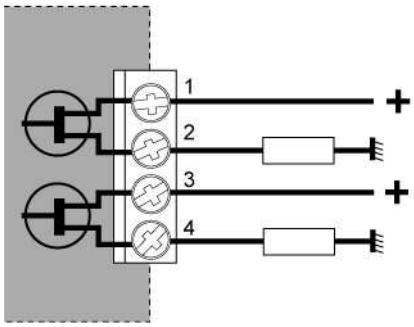
### 20.5.2 2 On/Off output card

Refer to paragraph 7.4.2, on page 20 for the technical details regarding these On/Off outputs.

It is essential to parameter this card using local or remote communication.

Connect the load and the connecting cable as follows:

| Card output | Terminal | Function |
|---|---|---|
| OUT1 | 1-2 | No.1 On/Off Output. |
| OUT2 | 3-4 | No.2 On/Off Output. |




*Example of connection of On/Off outputs. The polarities on the terminals 1-2 or 3-4 are indifferent.*

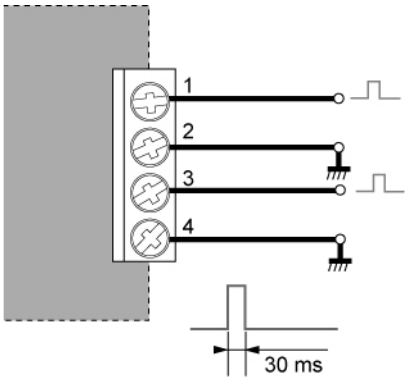
### 20.5.3 2 On/Off input card

See paragraph 7.4.3, on page 21 for the technical details regarding these On/Off inputs.

It is essential to parameter this card using local or remote communication.

Connect the input signal to the connecting cable as follows:

| Card input | Terminal | Function |
|---|---|---|
| IN1 | 1-2 | Signal input and earth. Polarities: indifferent. |
| IN2 | 3-4 | Signal input B and earth. Polarities: indifferent. |




*Example of connection of On/Off input in pulsed mode. The polarities on the terminals 1-2 or 3-4 are indifferent.*

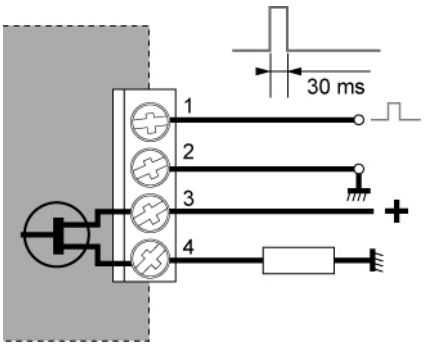
### 20.5.4 1 On/Off input and 1 On/Off output card

See paragraph 7.4.4, on page 21 for the technical details.

It is essential to parameter this card using local or remote communication.

Connect the input and the output as follows:

| Card output | Terminal | Function |
|---|---|---|
| IN1 | 1 | See paragraph 20.5.3. |
| IN2 | 2 | |
| OUT3 | 3 | See paragraph 20.5.2. |
| OUT4 | 4 | |




*Example of connection of the logic input and output. The polarities in the terminals are indifferent.*

## 20.6 Connection of the auxiliary source

Note: *ENERIUM* is delivered with one of these two types of power supplies. The type of power supply is notified on the back label.

### 20.6.1 High level supply

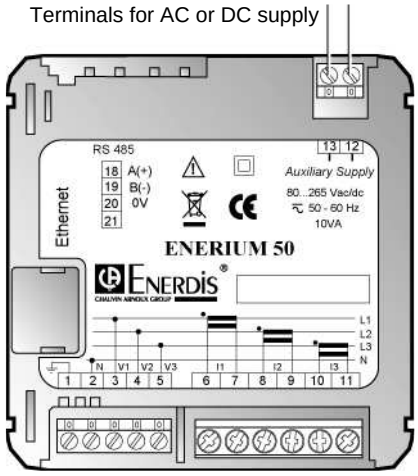
| | |
|---|---|
| Terminal 12 | Polarity indifferent. See paragraph 7.3, on page 20 for the technical details. |
| Terminal 13 | |

### 20.6.2 Continuous low level supply

| | |
|---|---|
| Terminal 12 | Polarity indifferent. See paragraph 7.3, on page 20 for the technical details. |
| Terminal 13 | |

Connect the A.C or D.C power supply as illustrated below.

Terminals for AC or DC supply




*Connection of the supply.*

A fuse protection is necessary.

# Use

# 21. OPERATING PROCEDURE

## 21.1 Complete Procedure

This paragraph describes the complete procedure for using *ENERIUM*.

### 21.1.1 Mechanical assembly

Refer to chapter19, on page 61.

### 21.1.2 Electrical assembly

Refer to chapter 20, on page 63.

### 21.1.3 Parametering

Refer to chapter 14, on page 43.

### 21.1.4 Measurement consultation

Use one of the following methods:

| Type of *ENERIUM* | See page |
|---|---|
| Manually from the display | 23 |
| Locally (PC and optical link) | 73 |
| Remote thru RS485 link | 73 |
| Remote thru Ethernet link | 73 |

## 21.2 How to …

### 21.2.1 Display the information

| Display | § | Page |
|---|---|---|
| ModBus Address (define) | 14.3 | 43 |
| ModBus Address (read) | 11.3.1 | 37 |
| Ethernet Address (define) | 14.4 | 44 |
| Ethernet Address (read) | 11.3.1 | 37 |
| Display (Scrolling and time) | 14.5 | 45 |
| Alarm (reset) | 12.3.2 | 40 |
| Alarms active on On/Off output | 12.3.1 | 39 |
| Stop Bit (RS485) | 14.3 | 43 |
| Configure the box | 21.1.3 | 71 |
| Currents (I) | 9.3.3 | 30 |
| Maximum average currents | 9.3.4 | 30 |
| Load curve | 17 | 55 |
| Recording curve | 18 | 57 |
| System Date | 11.3.3 | 38 |
| Automatic scrolling of screens | 14.5 | 45 |
| Fresnel Diagram | 16.2 | 51 |
| Customized screens | 13.2 | 41 |
| EP+ active energy | 10.3.1 | 33 |
| EP1 active energy | 10.3.2 | 34 |
| Apparent energy | 10.3.7 | 34 |
| Reactive energy | 10.3.3 | 34 |
| Ethernet – define IP address | 14.4 | 44 |
| Ethernet – read IP address | 11.3.1 | 37 |
| Fresnel (diagram) | 16.2 | 51 |
| Ph-Ph voltage harmonic | 9.3.9 | 31 |
| Current harmonic (I) | 9.3.10 | 31 |
| System time | 11.3.3 | 38 |
| Gauges | 16.2.4 | 52 |
| Display language | 14.5.3 | 45 |
| Password | 14.5.5 | 45 |
| Serial number of the box | 11.3.1 | 37 |
| Software version number | 11.3.1 | 37 |
| Parity (RS485) | 14.3 | 43 |
| Average power (P, S) | 9.3.6 | 30 |
| Powers (S, P, Q, FP) | 9.3.5 | 30 |
| Electrical network | 14.6 | 46 |
| Resetting of alarms | 12.3.2 | 40 |
| Reversal (temps – RS485) | 14.3 | 43 |
| RS485 (parametering) | 14.3 | 43 |
| Box operating time | 11.3.2 | 38 |
| Duration of network presence | 11.3.2 | 38 |
| Load duration | 11.3.2 | 38 |
| Ph-N (U) Voltages | 9.3.1 | 29 |
| Ph-Ph (V) Voltages | 9.3.2 | 29 |
| THD of the Ph-Ph voltage | 9.3.7 | 30 |
| Current THD (I) | 9.3.8 | 31 |
| Enerium Type | 11.3.1 | 37 |

| Display | § | Page |
|---|---|---|
| RS485 transmission speed | 14.3 | 43 |

### 21.2.2 Modify the parameters

| Display | § | Page |
|---|---|---|
| RS 485 remote communication * | 14.3 | 43 |
| Ethernet remote communication | 14.4 | 44 |
| Display | 14.5 | 45 |
| Electrical network | 14.6 | 46 |

*(*) The RS 485 and Ethernet interfaces cannot be present at the same time.*

# 22. LOCALE OR REMOTE COMMUNICATION

The local or remote communication enables parameter setting and reading of ENERIUM, either using the *E.set* or *E.view* application, or from any specific application using the ModBus protocol in RTU mode, (Optical or RS485 Interfaces) or ModBus TCP in RTU mode (Ethernet Interface).

For additional information regarding the ModBus/RTU and ModBus/TCP/RTU protocol, contact ENERDIS to obtain the MS0-7388 document– Mapping and command words.

## 22.1 *E.set* and *E.view* applications

The reader should refer to the specific reference manual for this software.

## 22.2 ModBus/RTU compatible specific application

### 22.2.1 Local communication by optical interface

The communication support is described in paragraphs 6.3 and 6.4, on pages 16 and 17.

Communication is performed in *half duplex* mode.

The functions implemented in the products are:

- Function 03 : Reading of N words.
- Function 04 : Reading of N words.
- Function 08 : Reading of diagnostic meters (For details, see below).
- Function 16 : Writing of N words.

The diagnostic meters are:

- Resetting of meters.
- Number of frames received without CRC.
- Number of frames received with CRC.
- Number of exceptional responses.
- Number of frames addressed to the station (outside distribution).
- Number of distribution requests received.
- Number of NAQ responses.
- Number of unready slave responses.
- Number of unprocessed characters.
- Number of responses outside the function 8.

The transmission format is fixed as follows:

- Speed of 38400 bauds.
- 1 start bit.
- 8 data bits.
- Without parity.
- 1 stop bit.
- Reversal time of 0 ms (see paragraph 22.2.2, on page 73, for the internal processing time).

The station responds to all the slave numbers between 1 and 247.

It is also possible to download, via the optical interface only, a new application in the station. In this case, a protocol different from *ModBus* is used.

### 22.2.2 Remote communication thru the RS485 interface

The communication support is described in paragraph 7.5, on page 21.

Communication is performed in *half duplex* mode.

The functions implemented in the products are:

- Function 03 : Reading of N words.
- Function 04 : Reading of N words.
- Function 08 : Reading of diagnostic meters (For the details see below).
- Function 16 : Writing of N words.

The diagnostic meters are:

- Resetting of meters.
- Number of frames received without CRC.
- Number of frames received with CRC.
- Number of exceptional responses.
- Number of frames addressed to the station (outside distribution).
- Number of distribution requests received.
- Number of NAQ responses.
- Number of unready slave responses.
- Number of unprocessed characters.
- Number of responses outside the function 8.

The processing of a frame addressed to slave 00 (i.e. all the slaves present on the network) is performed. The product does not send any response.

The transmission format is fixed with 1 start bit and 8 data bits. On the contrary, the slave number, parity, number of stop bits, reversal time and the transmission speed can be parametered.

The product address on the *ModBus* network can be parametered from 1 to 247, in increments of 1.

The communication speed can be parametered from among the values 2400, 4800, 9600, 19200, 38400 and 115200 bauds.

The communication parity can be parametered from among the following values: Odd, Even and without parity.

The number of stop bits for communication can be parametered among the values 1 and 2.

The reversal time is a waiting time between the receipt of the last of the three characters of the frame end and the issue of the first character of the response frame. The reversal time can be parametered from 0 to 500 ms, in increments of 50 ms.

Note: a reversal time configured for 0 ms is not the real reversal time, which is then equal to the internal processing time of the frame, which is around 35 ms. For other values, the parametered time is the real reversal time.

The default values are mentioned in paragraph 14.7, on page 47.

### 22.2.3 Remote communication thru the Ethernet interface

The communication support is described in paragraph 7.6, on page 22.

According to the status of the network, communication is performed in *half* or *full duplex* mode.

An IP address of 000.000.000.000 configures *ENERIUM* in DHCP (*Dynamic Host Configuration Protocol*). An IP address is thus automatically assigned to the product by the network's DHCP server.

To determine the allocated IP address and mask, use the *E.set* or *E.view* applications and launch the *Search* command under *Network/New Channel* with *Type of channel* parametered to *Ethernet* and *Port number* defined at *502*.

Knowing the serial number of the searched equipment, just establish the correspondence between the IP address and the serial number to know the IP address of the equipment.

It is possible to parameter the IP address, the mask of the sub-network and the gateway by the GUI (see paragraph 14.4, on page 44) or using local or remote communication.

# 23. MAINTENANCE

Since no electronic or electrical part is exchangeable by the end user, the measure station shall be returned to *Manumesure*, the distribution and after-sales center.

# Technical characteristics

# 24. CHARACTERISTICS

*ENERIUM* measures and calculates more than 50 electrical variables. All these variables are effective values (RMS).

Instantaneous variables are refreshed every second, except for the THDs, every six seconds.

The mini and maxi variables are updated every second if needed.

The average variables are calculated over a time programmable from 0 to 30 minutes. This variable is refreshed at every tenth period.

## 24.1 Measurements

| | 1S | MIN | MAX | AVG | AVG MIN | AVG MAX |
|---|---|---|---|---|---|---|
| V1, V2, V3, Vearth | ● | ● | ● | ● | | ● |
| U12, U23, U31 | ● | ● | ● | ● | | ● |
| I1, I2, I3, In | ● | ● | ● | ● | | ● |
| P1, P2, P3 | ● | | ● (1) | ● (1) | | |
| Pt | ● | ● (1) | ● (1) | ● (1) | | ● (1) |
| Q1, Q2, Q3 | ● | | ● (1) | ● (1) | | |
| Qt | ● | ● (1) | ● (1) | ● (1) | | ● (1) |
| S1, S2, S3 | ● | | ● | ● | | |
| St | ● | | ● | ● | | ● |
| FP1, FP2, FP3 | ● | | | ● (1) | | |
| FPt | ● | | | ● (1) | | ● (1) |
| Cosϕ1, Cosϕ2, Cosϕ3, | ● | | | ● (1) | | |
| Cosϕt, | ● | | | ● (1) | ● (1) | ● (1) |
| Tan ϕ, | ● | | | ● (1) | ● (1) | ● (1) |
| Frequency | ● | ● | ● | ● | | |
| Peak factor V1, V2, V3 | ● | | | ● | | ● |
| Peak factor I1, I2, I3 | ● | | | ● | | ● |
| Unbalance U | ● | | | ● | | ● |
| Harmonic (2) 1 to 50 V1, V2, V3, U12, U23, U31, I1, I2, I3 | ● | | | | | ● |
| THD V1, V2, V3, U12, U23, U31, I1, I2, I3 | ● | | | ● | | ● |
| Time meters: network presence, in load, auxiliary source | ● | | | | | |
| Active, Receiver, Generator Energy | ● | | | | | |
| Reactive Energy Qcad1 Qcad2, Qcad3, Qcad4 | ● | | | | | |
| Effective, Receiver, Generator Energy | ● | | | | | |
| Pulsed metering input On/Off1, On/Off2 | ● | | | | | |

*(1) also measures in generator and receiver mode* *(2) up to range 25 for ENERIUM 50*

## 24.2 Load curves

| Average values | |
|---|---|
| Pt Gen, Pt Rec | ● |
| Qcad1 Qcad2, Qcad3, Qcad4 | ● |
| St Gen, St Rec | ● |
| On/Off1, On/Off2 Inputs | ● |

## 24.3 Alarms

| 1 sec Values | |
|---|---|
| V1, V2, V3, Vearth | ● |
| U12, U23, U31 | ● |
| I1, I2, I3, In | ● |
| Pt | ● |
| Qt | ● |
| St | ● |
| FPt | ● |
| Cos ϕt | ● |
| Tan ϕ | ● |
| Frequency | ● |
| Unbalance U | ● |
| 3 time meters: network presence, loaded, Aux source. | ● |
| **Average values** | |
| Pt Gen, Qt Rec | ● |
| Qt Gen, Qt Rec | ● |
| St | ● |

## 24.4 Analog outputs

| 1 sec Values | |
|---|---|
| V1, V2, V3, Vearth | ● |
| U12, U23, U31 | ● |
| I1, I2, I3, In | ● |
| P1, P2, P3 | ● |
| Pt | ● |
| Q1, Q2, Q3 | ● |
| Qt | ● |
| S1, S2, S3 | ● |
| St | ● |
| FP1, FP2, FP3 | ● |
| FPt | ● |
| Cos ϕ1, Cos ϕ2, Cos ϕ3 | ● |
| Cos ϕt | ● |
| Tan ϕ | ● |
| Frequency | ● |

## 24.5 Recording curves

*(not available on ENERIUM 50)*

| 1 sec Values | |
|---|---|
| I1, I2, I3, In | ● |
| Pt | ● |
| Qt | ● |
| St | ● |
| FPt | ● |
| Unbalance U | ● |
| THD V1, V2, V3 | ● |
| THD U12, U23, U31 | ● |
| THD I1, I2, I3 | ● |
| **Average values** | |
| V1, V2, V3, | ● |
| I1, I2, I3, In | ● |
| P1 Gen, P1 Rec, P2 Gen, P2 Rec, P3 Gen, P3 Rec, Pt Gen, Pt Rec | ● |
| FP1 Gen, FP1 Rec, FP2 Gen, FP2 Rec, FP3 Gen, FP3 Rec, FPt Gen, FPt Rec | ● |
| Cosϕ1 Gen, Cosϕ1 Rec, Cosϕ2 Gen, Cosϕ2 Rec, Cosϕ3 Gen, Cosϕ3 Rec, Cosϕt Gen, Cosϕt Rec | ● |
| Frequency | ● |
| Peak factor V1, V2, V3 | ● |
| Peak factor I1, I2, I3 | ● |
| THD U12, U23, U31 | ● |
| THD I1, I2, I3 | ● |
| THD V1, V2, V3 | ● |

# 24.6 Electrical

## 24.6.1 Display

- LCD display, monochrome (128 lines, 160 pixels), backlit by white LEDs. Contrast adjustable by local or remote communication or via the local keyboard.
- On the main menu, display of 6 to 8 icons enabling the easy selection of variables to be visualised.
- Display of V, U, I, F, P, Q, S, FP, Tanϕ, THD variables, energies and harmonics.
- Display of pictograms (alarm, phass order, communication, automatic scrolling, inductive network, capacitive network, generator network),
- Display of texts dans 5 languages (German, English, Spanish, French, Italian).
- Forced setting of the screen possible after activation by local or remote communication.
- Automatic scrolling of screens specific to the user.

## 24.6.2 Keys

- "OK" key for validation of choice.
- Joystick (4 ▲▼◀▶ keys) for selection and navigation.

## 24.6.3 Voltage measurement inputs

| Variable | Range |
|---|---|
| Nominal ground voltage | 57.7 / 230 V |
| Nominal line voltage | 100 V / 400 V |
| Maximum line voltage | 120 V / 480V (which is 100/400V $^{+20\%}$) |
| Peak factor | 2 |
| Frequency | 42,5Hz (which is 50Hz $^{-15\%}$) to 69Hz (which is 60Hz $^{+15\%}$) |
| Maximum measured line voltage | 650.0kV (primary side view from the client transformer) |
| Permanent Surge | Twice the line voltage of nominal input, which is 800V. |
| Consumption per phase | <0.2 VA |
| Impedance | 500 kΩ |
| Non-detachable terminals | 5 connection points. Screw terminals, with mobile cage.<br>Connection of rigid or flexible wires of section 0 to 2.5 $mm^2$ (22-14 AWG).<br>Maximum acceptable coupling torque on the terminal : 0.4 Nm. |
| Setting range | TP primary from 100 V to 650 000 V in steps of 1 V.<br>TP secondary from 100 V to 480 V in steps of 1 V. |

## 24.6.4 Current measurement inputs

| Variable | Range |
|---|---|
| Nominal input current | 5 A |
| Maximum input current | 6.5A (which is 5A $^{+30\%}$) |
| Peak factor | 3 |
| Frequency | 42,5Hz (which is 50Hz $^{-15\%}$) to 69Hz (which is 60Hz $^{+15\%}$) |
| Maximum measured current | 25,0 kA (primary side view from the client transformer). |
| Consumption | <0.15 VA |
| Excees current | 50 times the nominal current, which is 250A, for a duration of 1s supported 5 times to follow every 5 minutes. |
| Three-phase maximum active power | 1.2 GW (primary side view from the client transformer). |
| Non-detachable terminals | 6 connection points. Screw terminals, with mobile cage.<br>Connection of rigid or flexible wires of section 0.5 to 6$mm^2$ (20-10 AWG).<br>Maximum acceptable Coupling torque on the terminal: 0.8 Nm. |
| Setting range | TP primary from 1 A to 25 000 A in steps of 1 A.<br>TP secondary from 1 A to 5 A in steps of 1 A. |

## 24.6.5 RS485 Output Communication

The RS485 card cannot be present at the same time as the Ethernet card.

| Item | Characteristics |
|---|---|
| Protocol | ModBus RTU mode. |
| Speed | 2400, 4800, 9600, 19 200 and 115 200 Bauds. |
| Parity | without, even or odd. |
| Number of stop bits | 1 or 2 |
| Connection | 2 fils + shielding, half duplex |
| Detachable terminals | 3 connection points. Screw terminals.<br>Connection of rigid or flexible wires of section 0.2 to 2.5 $mm^2$ (22-14 AWG)<br>Maximum acceptable Coupling torque on the terminal : 0.4 Nm. |

### Ethernet Output

The Ethernet card cannot be present at the same time as the RS485 card.

| Item | Characteristics |
|---|---|
| Protocol | ModBus / TCP in RTU mode. |
| Speed | 10/100 Base T |
| Maximum length | Transmission over 100 m max. |
| Connection | 8 points RJ45 socket. |

### Optical Interface

| Item | Characteristics |
|---|---|
| Protocol | ModBus in RTU mode. |
| Transmission Format | Fixed at the speed of 38400 bauds, 1 start bit, 8 data bits, without parity, 1 stop bit and a reversal time of 0 ms. Responds to all the slave numbers between 1 and 247. |
| Digital input/output | Optical (infrared) ensuring optical bidirectional transmission. |
| Connection | By optical cord without electrical contact. |

### 24.6.6 Auxiliary supply source

| Source | Characteristics |
|---|---|
| A.C/D.C (high tension) (*) | 80 Vac/dc (or 100 Vac/dc $^{-20\%}$) to 265 Vac/dc (or 230 Vac/dc $^{+15\%}$).<br>Frequency between 42.5 Hz (or 50 Hz $^{-15\%}$) and 69 Hz (or 60 Hz $^{+15\%}$) in A.C. |
| Low tension D.C (*) | 19 Vdc (or 24 Vdc $^{-20\%}$) to 58 Vdc (or 48 Vdc $^{+20\%}$). |
| Consumption | <15 VA – 10 W. |
| Non-detachable terminals | 2 connection points. Screw terminals, with mobile cage.<br>Connection of rigid or flexible wires of section 0 to 2.5 mm$^2$ (22-14 AWG).<br>Maximum acceptable coupling torque on the terminal : 0.4 Nm. |

(*): Either model. Supply mounted by the manufacturer

### 24.6.7 Information retention

The information saved after a supply break is the:

- Parametering
- Average values
- Minimum values
- Maximum values
- Energy meters
- Pulse meters
- Event files
- Time meters
- Load curves
- Recording curves.

| Item | Characteristics |
|---|---|
| Information retention | 10 years at 25 °C. |
| Retention date/time | 5 days. |

## 24.7 Optional cards

### 24.7.1 Terminal characteristics

| Item | Characteristics |
|---|---|
| Number of admissible optional cards: | 1 per *ENERIUM*. |
| Detachable terminals | 2 x 2 connection points. Screw terminals.<br>Connection of rigid or flexible wires of section 0 to 2.5 mm$^2$ (22-14 AWG).<br>Maximum acceptable coupling torque on the terminal : 0.4 Nm. |

### 24.7.2 2 output analog card

| Item | Characteristics |
|---|---|
| Number of outputs | 2. |
| Output Signal | D.C. |
| Maximum resistive load | 10 V / I output |
| Maximum capacitive load | 0.1 µF. |
| Response time | 500 ms. |
| Isolation between outputs | 1 kV – 1 min. |
| Limits (min and max) | -22 mA, ≤ $I_{output}$ ≤+ 22 mA. |

### 24.7.3 2 On/Off inputs card

| Item | Characteristics |
|---|---|
| Number of inputs | 2. |
| Input Signal | Continuous. |
| Amplitude of the input signal | Between 19.2 Vdc (or 24 Vdc $^{-20\%}$) and 72 Vdc (or 60 Vdc $^{+20\%}$). |
| Level Interpretation | Amplitude < 5 V: the logic level read is "0".<br>Amplitude > 10 V: the logic level read is "1".<br>The signal width should be at the minimum 30 ms. |
| Absorbed power | <0.5 W per On/Off input. |
| Isolation between outputs | 2.2 kV – 1 min. |
| Type of protection | Optocoupler. |

### 24.7.4 2 On/Off output card

| Item | Characteristics |
|---|---|
| Number of outputs | 2. |
| Maximum admissible current | ≤ 100 mA. |
| Output signal | D.C. signal varying from 19.2Vdc (or 24 Vdc $^{-20\%}$) to 265 Vdc (or 220 Vdc $^{+20\%}$). |
| | A.C. frequency signal between 42.5 Hz and 69 Hz, varying from 19.2 Vac (or 24 Vac $^{-20\%}$) to 265 Vac (or 230 Vac $^{+15\%}$). |
| Output in pulsed mode | Complies with CEI 62053-31 (1998) standard. |
| Isolation between outputs | 2,2 kV – 1 min. |
| Type of contact | Dry contact. |
| Type of protection | Static relay (bidirectional MOS transistor). |

### 24.7.5 1 On/Off input and 1 On/Off output card

Electrical characteristics identical to those of the “1 On/Off input” and “1 On/Off output” cards described in paragraph 24.7.3 on page 82 and 24.7.4 on page 83.

The differences are found in the number of inputs and outputs available on the card, i.e.:
- Number of On/Off inputs: 1
- Number of On/Off outputs: 1

## 24.8 Metrology

(A 23°C ±2°C, 50Hz (except for variable F))

$V_{nom}/U_{nom}$ = 230 V / 400 V for TP secondary > 100 V

$V_{nom}/U_{nom}$ = 57,7 V / 100 V for TP secondary = 100 V

$I_{nom}$ = 5A

| Variable | Conditions | Accuracy |
|---|---|---|
| V | V between [10% and 120%] of $V_{nom}$ | ±0,2% of the measurement<br>±0,02% of $V_{nom}$ |
| U | U between [10% and 120%] of $U_{nom}$ | ±0,2% of the measurement<br>±0,02% of $U_{nom}$ |
| I | I between [5% and 130%] of $I_{nom}$ | ±0,2% of the measurement<br>±0,02% of $I_{nom}$ |
| F | F between [42,5Hz and 69Hz] | ± 0,1Hz |
| CH | - | ± 250ppm |
| P | FP equals 1<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±0,5% of the measurement<br>±0,02% of $P_{nom}$ |
| | FP between [0.5 inductive and 0.8 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [10% and 130%] of $I_{nom}$ | ±0,5% of the measurement<br>±0,05% of $P_{nom}$ |
| Q | Sin (ϕ) = 1<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±1% of the measurement |
| | I between [2% and 5%[ of $I_{nom}$ | ±1,5% of the measurement |
| | Sin (ϕ) lying between [0.5 inductive and 0.5 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [10% and 130%] of $I_{nom}$ | ±1% of the measurement |
| | I between [5% and 10%[ of $I_{nom}$ | ±1,5% of the measurement |
| | Sin (ϕ)between [0,25 inductive and 0,25 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [10% and 130%] of $I_{nom}$ | ±3,5% of the measurement |
| S | V between [99% and 101%] of $V_{nom}$ | ±0,5% of the measurement |
| | I between [5% and 130%[ of $I_{nom}$ | ±0,02% of $S_{nom}$ |
| Cos(ϕ) | Cos(ϕ)between [0.5 inductive and 0.5 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±0,02 points |
| | Cos(ϕ)between [0.2 inductive et 0.2 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±0,05 points |
| Tan(ϕ) | Tan(ϕ)between [1.732 inductive and 1.732 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±0,02 points |
| | Tan(ϕ)between [4.90 inductive and 4.90 capacitive]<br>V between [99% and 101%] of $V_{nom}$ | |
| | I between [5% and 130%] of $I_{nom}$ | ±0,05 points |

| Variable | Conditions | Accuracy |
|---|---|---|
| FP | FP between [0.5 inductive and 0.5 capacitive]<br>V between [99% and 101%] of $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ | ±0,02 points |
| | FP between [0.2 inductive and 0.2 capacitive]<br>V between [99% and 101%] of $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ | ±0,05 points |
| Active E | FP equals 1<br>V between [99% and 101%] of $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ | ± 0.5% of the measurement |
| | I between [1% and 5%] of $I_{nom}$ | ± 1% of the measurement |
| | FP between [0.5 inductive and 0.8 capacitive]<br>V between [99% and 101%] of $V_{no\ m}$<br>I between [10% and 130%] of $I_{nom}$ | ± 0.6% of the measurement |
| | I between [2% and 10%[ de $I_{nom}$ | ± 1% of the measurement |
| Reactive E | Sin (ϕ) = 1<br>V between [99% and 101%] of $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ = 5 A | ± 1% of the measurement |
| | I between [2% and 5%[ of $I_{nom}$ | ± 1.5% of the measurement |
| | FP between [0.5 inductive and 0.5 capacitive]<br>V between [99% and 101%] of $V_{nom}$<br>I between [10% and 130%] of $I_{nom}$ | ± 1% of the measurement |
| | I between [5% and 10%[ of $I_{nom}$ | ± 1.5% of the measurement |
| | FP between [0.25 inductive and 0.25 capacitive]<br>V between [99% and 101%] of $V_{nom}$<br>I between [10% and 130%] of $I_{nom}$ | ± 3% of the measurement |

| Variable | Conditions | Accuracy |
|---|---|---|
| Effective E | V between [99% and 101%] of $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ | ± 0.5% of the measurement |
| Harmonics per range | FP equalsl 1<br>V between [99% and 101%] de $V_{nom}$<br>I between [5% and 130%] of $I_{nom}$ | ± 0.5 points |
| THD | FP equals 1<br>V lying between [99% and 101%] of $V_{nom}$<br>I lying between [5% and 130%] of $I_{nom}$ | ± 0.5 points |
| Time | T = 23 °C | ± 20ppm<br>(or ± 52 seconds over 30 days) |

## 24.9 Mechanical

| | |
|---|---|
| Overall Dimensions (mm) : | 96*96*55 (H, L, D) |
| Weight: | <600 g. |
| Assembly: | On panel according to DIN 43700. |
| Format: | DIN 96 x 96. |
| Dimension of the cutting: | 92 x 92 mm. |
| Fastening: | by angle fastening (panel assembly). |
| Name plate | on the rear part of the equipment. |
| Device number | on the rear part of the equipment. |

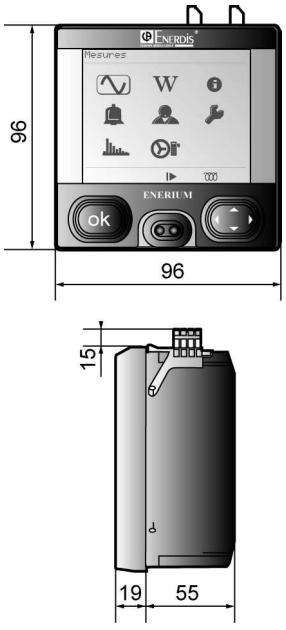



*Figure 24-1 : dimensions in millimeters.*040

# 24.10 Environmental constraints

## 24.10.1 Climatic constraints

| | |
|---|---|
| Operating temperature: | -10 to 55 °C. |
| Operating humidity: | Up to 95% at 40 °C. |
| Storage temperature: | -25 to +70 °C. |

## 24.10.2 Safety constraints

| | |
|---|---|
| Level of pollution : | 2 |
| Resistance to fire: | Complies with UL94 standard for the severity level V1. |
| Installation category | III |

## 24.10.3 Mechanical constraints

| | |
|---|---|
| Protection index : | According to CEI 60529, for the following severity level:<br>IP 51 Index (front face).<br>IP 20 Index (rear face). |
| Mechanical shocks: | According to CEI 61010-1. |
| Vibrations: | CEI 60068-2-6 (A method). |
| Free fall with packing | From a height of 1 m, according to the NF H 0042-1 standard. |

## 24.10.4 Electromagnetic compatibility

| |
|---|
| According to the CEI 61326-1 standard |

# 24.11 Accessories

| | |
|---|---|
| Optical cable: | For local communication;<br>Connection to a PC by minimum USB 1.1 plug.<br>Cable sold separately. |
| Software: | Configuration software *E.view or E.set*. |

# 25. MEASURED VARIABLES

This chapter presents the mathematical formulas used for the calculation of the different measurements by *ENERIUM*.

## 25.1 Ground voltage

The measurements are performed from the "10-period'' ground voltage measurements for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas are:

$V_L[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} V_L^2[10T]}$ (For F=50Hz) or

$V_L[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} V_L^2[12T]}$ (For F=60Hz)

With $V_L[10T] = \sqrt{\frac{1}{10} \times \sum_{1}^{10} V_L^2[T]}$ , $V_L[12T] = \sqrt{\frac{1}{12} \times \sum_{1}^{12} V_L^2[T]}$

and $V_L[T] = \sqrt{\frac{1}{128} \times \sum_{1}^{128} v_L^2}$

L = 1, 2, 3, T

## 25.2 Line voltages

The measurements are performed from the "10-period'' measurements of line voltages for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas are:

$U_{ab}[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} U_{ab}^2[10T]}$ (For F=50Hz) or

$U_{ab}[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} U_{ab}^2[12T]}$ (For F=60Hz)

With $U_{ab}[10T] = \sqrt{\frac{1}{10} \times \sum_{1}^{10} U_{ab}^2[T]}$ ,

$U_{ab}[12T] = \sqrt{\frac{1}{12} \times \sum_{1}^{12} U_{ab}^2[T]}$

and $U_{ab}[T] = \sqrt{\frac{1}{128} \times \sum_{1}^{128} (v_a - v_b)^2}$

ab = 12, 23 ou 31

## 25.3 Current

The measurements are perfomed from the "10-period"'' current measurements for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas are:

$I_L[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} I_L^2[10T]}$ (For F=50Hz) or

$I_L[1s] = \sqrt{\frac{1}{5} \times \sum_{1}^{5} I_L^2[12T]}$ (For F=60Hz)

With $I_L[10T] = \sqrt{\frac{1}{10} \times \sum_{1}^{10} I_L^2[T]}$

and $I_L[12T] = \sqrt{\frac{1}{12} \times \sum_{1}^{12} I_L^2[T]}$

L = 1, 2, 3, N

For L=1,2 et 3 : $I_L[T] = \sqrt{\frac{1}{128} \times \sum_{1}^{128} i_L^2}$

And for L = N $I_L[T] = \sqrt{\frac{1}{128} \times \sum_{1}^{128} (i_1 + i_2 + i_3)^2}$

## 25.4 Active power

The measurements are performed from the "10-period'' measurements of active powers for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas are:

$P_L[1s] = \frac{1}{5} \times \sum_{1}^{5} P_L[10T]$ (For F=50Hz) or

$P_L[1s] = \frac{1}{5} \times \sum_{1}^{5} P_L[12T]$ (For F=60Hz)

With $P_L[10T] = \frac{1}{10} \times \sum_{1}^{10} P_L[T]$ ,

$P_L[12T] = \frac{1}{12} \times \sum_{1}^{12} P_L[T]$

and $P_L[T] = \frac{1}{128} \times \sum_{1}^{128} v_L \times i_L$

L = 1, 2, 3.

$P[1s]$ is the sum of active powers at the second :

$P[1s] = P_1[1s] + P2[1s] + P3[1s]$

## 25.5 Transit direction of powers

The products measure the transit direction of the powers "at the second".

- If P[1s] is positive, the transit direction of the powers is the Receiver.
- If P[1s] is negative, the transit direction of the powers is the Generator.

## 25.6 Reactive power

The products measure the reactive powers "at the second" on each of the $Q_1$[1s], $Q_2$[1s] and $Q_3$[1s] phases, as well as the three-phase reactive power "at the second" Q[1s].

The measurements are performed from other measurements, according to the following formula:

$$Q_L[1s] = SigneQ_L[1s]\sqrt{S_L^2[1s] - P_L^2[1s]}$$

L = 1, 2 or 3

$SigneQ_L[1s]$ is the sign of the reactive power, developed from the simplified Hilbert transformation.

***For F = 50 Hz :***

$$SigneQ_L[1s] = \text{Sign of} \sum_{i=1}^{6400} \sqrt{v_{(i-1)} * (i_1 - i_{(i-2)})}$$

***For F = 60 Hz*** :

$$SigneQ_L[1s] = \text{Sign of} \sum_{i=1}^{7800} \sqrt{i_{(i-1)} * (i_1 - i_{(i-2)})}$$

Q[1s] is the sum of "at the second" reactive powers Q[1s] = $Q_1$[1s] + $Q_2$[1s] + $Q_3$[1s].

## 25.7 Apparent Power

The products measure the apparent powers "at the second" on each of the $S_1$[1s], $S_2$[1s] and $S_3$[1s] phases, as well as the three-phase apparent powers "at the second" S[1s].

The measurements are performed from other measurements, according to the following formula:

$S_L[1s] = V_L[1s] \times I_L[1s]$. L = 1, 2 or 3

S[1s] is the sum of apparent powers "at the second" S[1s] = $S_1$[1s] + $S_2$[1s] + $S_3$[1s].

## 25.8 Power factor

The products measure the power factors "at the second" on each of the $FP_1$[1s], $FP_2$[1s] and $FP_3$[1s] phases, as well as the three-phase power factor "at the second" FP[1s].

The measurements are performed from other measurements, according to the following formula.

$FP_L[1s] = \dfrac{P_L[1s]}{S_L[1s]}$ L = 1, 2, 3 or nothing for the three-phase.

The quadrant is associated to each of these variables. If $P_x$[1s] and $Q_x$[1s] (x = 1, 2, 3 or nothing for the three-phase variable) are of the same sign, then the quadrant is selfic; otherwise, it is capacitive.

## 25.9 Cos(φ)

The products measure the cos(φ) "at the second" on each of the cos($\varphi_1$)[1s], cos($\varphi_2$)[1s], cos($\varphi_3$)[1s] phases, as well as the global cos(φ) "at the second" called cos($\varphi_g$)[1s].

The cos(φ) are calculated according to the following formula :

$$\cos(\varphi_L)[1s] = \frac{1}{5} \times \sum_1^5 \cos(\varphi_L)[10T] \text{ (For F=50Hz) } \textbf{OR}$$

$$\cos(\varphi_L)[1s] = \frac{1}{5} \times \sum_1^5 \cos(\varphi_L)[12T] \text{ (For F=60Hz)}$$

L = 1, 2 and 3

and

$$\cos(\varphi_{global})[1s] = \frac{\cos(\varphi_1)[1s] + \cos(\varphi_2)[1s] + \cos(\varphi_3)[1s]}{3}$$

with

$\cos(\varphi_L)[10T] = \cos(Angle\_V_L\_Fondamental[10T] - Angle\_I_L\_Fondamental[10T])$

and

$\cos(\varphi_L)[12T] = \cos(Angle\_V_L\_Fondamental[12T] - Angle\_I_L\_Fondamental[12T])$

The quadrant is associated to each of these variables.

- If the angle φ is between 0° and 90° or between 180° and 270°, then the quadrant is selfic.
- If the angle φ is between 90° and 180° or between 270° and 360°, then the quadrant is capacitive.

## 25.10 Peak factor

The measurements are performed from the "10-period'' active power measurements for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas are:

### 25.10.1 For the voltages

$FC_{VL}[1s]=\frac{1}{5}\times\sum_{1}^{5}FC_{VL}[10T]$ (For F=50Hz) or

$FC_{VL}[1s]=\frac{1}{5}\times\sum_{1}^{5}FC_{VL}[12T]$ (For F=60Hz)

with $FC_{VL}[10T]=\frac{Vpeak[10T]}{V[10T]}$

and $FC_{VL}[12T]=\frac{Vpeak[12T]}{V[12T]}$

with $V[10T]=\sqrt{\frac{1}{1280}\times\sum_{1}^{1280}v_L^2}$

and $V[12T]=\sqrt{\frac{1}{1536}\times\sum_{1}^{1536}v_L^2}$

with $Vpeak[10T]=\max[abs(v_L)]$

and $Vpeak[12T]=\max[abs(v_L)]$

L = 1, 2, 3

### 25.10.2 For the currents

$FC_{IL}[1s]=\frac{1}{5}\times\sum_{1}^{5}FC_{IL}[10T]$ (For F=50Hz)

**OR** $FC_{IL}[1s]=\frac{1}{5}\times\sum_{1}^{5}FC_{IL}[12T]$ (For F=60Hz)

with $FC_{IL}[10T]=\frac{Ipeak[10T]}{I[10T]}$

and $FC_{IL}[12T]=\frac{Ipeak[12T]}{I[12T]}$

with

$I[10T]=\sqrt{\frac{1}{1280}\times\sum_{1}^{1280}i_L^2}$ and $I[12T]=\sqrt{\frac{1}{1536}\times\sum_{1}^{1536}i_L^2}$

With $Ipeak[10T]=\max[abs(i_L)]$ and

$Ipeak[12T]=\max[abs(i_L)]$

L = 1, 2, 3

## 25.11 Tan(φ)

The product measures the global "at the second'' Tan(φ) .

The quadrant is associated with each of these variables. If P[1s] and Q[1s] (three-phase variable) are of the same sign, then the quadrant is selfic, otherwise it is capacitive.

$$tg(\varphi_g)[1s]=\frac{Q[1s]}{P[1s]}$$

## 25.12 Frequency

The measurements are performed from the measurements of "10-period'' active powers for a network frequency parametered at 50Hz and "12-period'' for a network frequency parametered at 60Hz. The formulas ares:

$$F[1s]=F\_sampling \quad x \quad \frac{10T}{Nbr\_Samples\_on\_10T}$$

With the following functional relationship: F_sampling = 128 * F[1s]

## 25.13 Harmonics

The products measure the harmonic rate $H_x$ "at the second", range by range, on the three ground voltages $V_1$, $V_2$, $V_3$, on the three line voltages $U_{12}$, $U_{23}$, $U_{31}$ and on the three currents $I_1$, $I_2$, $I_3$, in compliance with the CEI 61000-4-7 standard (edition 2). The measurements are performed from the harmonics hx[10T], according to the formula :

$$H_x[1s]=\sqrt{\frac{\sum_{1}^{5}h_x^2[10T]}{\sum_{1}^{5}h_1^2[10T]}}$$

When the ground voltage, line voltage or current is equal to 0, then the harmonic rate of the concerned variable is not calculated and its value is 0.

In the case of *ENERIUM 50*, the measurement is performd up tol range 25. In the case of *ENERIUM 150*, the measurement is performed up to range 50.

## 25.14 Harmonics rate

The products measure the harmonic rate "at the second'' on the three ground voltages $THD_{V1}$[1s], $THD_{V2}$[1s], $THD_{V3}$[1s], on the three line voltages $THD_{U12}$[1s], $THD_{U23}$[1s] and $THD_{U31}$[1s], as well as on the three currents $THD_{I1}$[1s], $THD_{I2}$[1s] and $THD_{I3}$[1s], according to the definition of the CEI 60050-551-20 standard.

The measurements are performed from the range by range harmonics "at the second'', calculated according to the following formula:

$$THD = 100 \times \sqrt{\frac{\sum_{n=2}^{50} H_n^2}{H_1^2}}$$

When the ground voltage, line voltage or the current is equal to 0, the harmonic rate of the concerned variable is not calculated and its value is 0.

# 25.15 Energy and Energy metering

The products calculate "at the second'' the active energy EP[1s], reactive energy EQ[1s] and the apparent energy ES[1s].

The measurements are performed from other measurements already calculated, according to the following formula:

$$EX[1s] = M[1s] \times \frac{N_{ech}}{3600 \times F_{ech}}.$$ X = P, Q or S.

The energies are measured in absolute values, they are thus always positive.

M is the variable measured "at the second'' (Active, Reactive or Apparent power). $N_{ech}$ is the number of samples collected during the sampling window. $F_{ech}$ is the sampling frequency.

According to the quadrant, the energy measured is added in an total meter.

- If P[1s] is positive, the EP[1s] energy measurement is added to the active energy meter in receiver mode $CEP_R$ and the measurement of ES[1s] energy is added to the apparent energy meter in receiver mode $CES_R$.
- If P[1s] is negative, the EP[1s] energy measurement is added to the active energy meter in generator mode $CEP_G$ and the measurement of ES[1s] energy is added to the apparent energy meter in generator mode $CES_G$.
- If P[1s] and Q[1s] are positive, the EQ[1s] energy measurement is added to the reactive energy meter of the first quadrant $CEQ_1$. If P[1s] is negative and Q[1s] is positive, the EQ[1s] energy measurement is added to the reactive energy meter of the second quadrant $CEQ_2$. If P[1s] is positive and Q[1s] is negative, the EQ[1s] energy measurement is added to the reactive energy meter of the third quadrant $CEQ_4$. If P[1s] and Q[1s] are negative, the EQ[1s] energy measurement is added to the reactive energy meter of the fourth quadrant $CEQ_3$.

It is possible to reset all the meters using a command word on the local or remote communication. It is also possible to reinitialize a meter independently from another, with a value, also using a command word on the local or remote communication.

# 25.16 Unbalance

The products calculate every second the voltage unbalance rate called Des[1s], from the measurements of the line voltages "at the second'' and according to the following algorithm:

Thus variables Fact1 and Fact2, such as:

$$Fact1 = U_{12}{}^2[1s] + U_{23}{}^2[1s] + U_{31}{}^2[1s]$$

$$Fact2 = U_{12}{}^4[1s] + U_{23}{}^4[1s] + U_{31}{}^4[1s]$$

Or the variable Fact3, such as:

If $(3 \times Fact1^2 - 6 \times Fact2) < 0$

Then $Fact3 = 0$

Else $Fact3 = \sqrt{3 \times Fact1^2 - 6 \times Fact2}$

Or the variable Fact4, such as:

If $(6 \times Fact2 - 2 \times Fact1^2) < 0$

Then $Fact4 = 0$

Else $Fact4 = \sqrt{6 \times Fact2 - 2 \times Fact1^2}$

If $Fact4 > 0$ Then

$$\mathrm{Des}[1s] = 1000 \times \frac{(Fact1 - Fact3)}{Fact4}$$

Else $\mathrm{Des}[1s] = 0$

# 25.17 Phase order

This function executes the cabling test, by verification of the phase order on the voltage lines. The calculation is performed over 3 periods and every 10 periods of the input reference signal. If the phase order is incorrect, as pictogram lights up in the lower strip of the visualization screens.

# 25.18 Time meter

The products integrate three time meters.

- The first time meter totals the time during which the product is active, i.e. the period during which the auxiliary source is present. This time meter is called “Auxiliary source presence’’ time meter.
- The second time meter totals the time during which the “one second’’ measurement of at least one ground voltage, from among $V_1$[1s], $V_2$[1s] et $V_3$[1s], is different form zero. This time meter is called “network presence’’ time meter.
- The third time meter totals the time during which the “one second’’ measurement of at least one current from among $I_1$[1s], $I_2$[1s] et $I_3$[1s], is different from zero. This time meter is called “load presence’’ time meter.

# 25.19 Average variable

The averages are sliding averages, updated every tenth of the integration duration. The integration duration is common to all variables. This integration duration is chosen from among the following predefined values: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 minutes.

All the average values can be updated by writing a command word on the local or remote communication. The reinitialization consists of placing the 0 value in the variable, with the exception of averages of the variables of type $FP_x$ and cos ($\varphi_x$), for which the reinitialization consists of placing the value 1.

## 25.19.1 Quadratic averages

The products calculate the quadratic averages of the “at the second’’ variables in the four quadrants. These averages are the following:

- $V_1$[aver], V2[aver], V3[aver]
- U12[aver], U23[aver], U31[aver]
- I1[aver], I2[aver], I3[aver], IN[aver]

The averages listed above are calculated according to the following formula:

$$X[moy] = \sqrt{\frac{1}{N} \times \sum_{i=1}^{N} X[1s]_i^2}$$

## 25.19.2 Arithmetic averages (A)

The products calculate the arithmetic averages of “at the second’’ variables in the four quadrants. These averages are the following:

- S1[aver], S2[aver], S3[aver], S[aver]
- F[aver], Des[aver]
- THDV1[aver], THDV2[aver], THDV3[aver]
- THDU12[aver], THDU23[aver], THDU31[aver]
- THDI1[aver], THDI2[aver], THDI3[aver]
- FCV1[aver], FCV2[aver], FCV3[aver]
- FCI1[aver], FCI2[aver], FCI3[aver]

The averages listed above are calculated according to the following formula:

$$X[moy] = \frac{1}{N} \times \sum_{i=1}^{N} X[1s]_i$$

## 25.19.3 Arithmetic averages (B)

The products calculate the arithmetic averages of “at the second’’ variables in the two quadrants in receiver mode. These averages are the following:

- $P_1$R[aver], P2R[aver], P3R[aver], PR[aver]
- Q1R[aver], Q2R[aver], Q3R[aver], QR[aver]

In the case where $P_x$[1s] is positive or nil (receiver mode), it is the value measured “at the second’’ which is taken into account in the average. When $P_x$[1s] is negative (generator mode), it is the value 0 which is taken into account in the average.

## 25.19.4 Arithmetic averages (C)

The products calculate the arithmetic averages of “at the second’’ variables in the two quadrants in receiver mode. These means are the following:

- FP1R[aver], FP2R[aver], FP3R[aver], FPR[aver]
- cos(φ1)R[aver], cos(φ2)R[aver], cos(φ3)R[aver], cos(φg)R[aver]

In the case where $P_x$[1s] is positive or nil (receiver mode), it is the value measured “at the second’’ which is taken into account in the average. When $P_x$[1s] is negative (generator mode), it is the value 1 which is taken into account in the average.

## 25.19.5 Arithmetic averages (D)

The products calculate the arithmetic average of “at the second’’ variables in the two quadrants in generator mode. These averages are the following:

- $P_1$G[aver], P2G[aver], P3G[aver], PG[aver],
- Q1G[aver], Q2G[aver], Q3G[aver], QG[aver]

In the case where $P_x$[1s] is negative (generator mode), it is the value measured “at the second’’ which is taken into account in the average. When $P_x$[1s] is positive or nil (receiver mode), it is the value 0 which is taken into account in the average.

## 25.19.6 Arithmetic means (E)

The products calculate the arithmetic averages of “at the second’’ variables in the two quadrants in generator mode. These means are the following:

- $FP_1$G[aver], FP2G[aver], FP3G[aver], FPG[aver]
- cos(φ1)G[aver], cos(φ2)G[aver], cos(φ3)G[aver], cos(φg)G[v]

In the case where $P_x$[1s] is negative (generator mode), it is the value measured “at the second’’ which is taken into account in the average. When $P_x$[1s] is positive or nil

(receiver mode), it is the value 1 which is taken into account in the average.

# 25.20 Calculation of minima

Each minimum is timestamped (date and time of detection of the minimum). All the minima can be reinitialized by writing a command word over the local or remote communication. The reinitialization consists of placing the value 0 in the variable, with the exception of the minima of variables of type $FP_x$ and cos ($\varphi_x$), for which the reinitialisation consists of placing the value 1.

# 25.21 Minima of variables

## 25.21.1 Minima (A)

The products calculate the minima of "at the second'' variables in the four quadrants. These minima are the following:

$V_1$[min], V2[min], V3[min]

- U12 [min], U23[min], U31[min]
- I1[min], I2[min], I3[min], IN[min]
- F[min]

The minima listed above are developed according to the following algorithm:

Si $\left(X[1s] < X[\min]\right)$

Then $\left(X[\min] = X[1s]\right)$

with X = $U_{ab}$, $I_L$ ou F

ab=12, 23 or 31

L = 1, 2 or 3.

## 25.21.2 Minima (B)

The products also calculate the minima of "at the second'' variables in the two quadrants corresponding to the receiver mode. These minima are the following:

- $P_1$R[min], $P_2$R[min], P3R[min], PR[min]
- Q1R[min], Q2R[min], $Q_3$R[min], QR[min]

The minima listed above are developed according to the following algorithm:

If $\left(X[1s] < XR[\min]\right)$ AND $\left(\mathrm{P}[1s] \geq 0\right)$

Then $\left(XR[\min] = X[1s]\right)$ with X = P or Q.

## 25.21.3 Minima (C)

The products also calculate the minima of "at the second'' variables in the two quadrants corresponding to the generator mode. These minima are the following:

- $P_1$G[min], $P_2$G[min], $P_3$G[min], PG[min],
- $Q_1$G[min], $Q_2$G[min], $Q_3$G[min], QG[min]

The minima listed above are developed according to the following algorithm:

If $\left(X[1s] < XG[\min]\right)$ AND $\left(\mathrm{P}[1s] < 0\right)$

Then $\left(XG[\min] = X[1s]\right)$ with X = P or Q.

# 25.22 Minima of average variables

## 25.22.1 Minima (A)

The products also calculate the minima of average variables in the two quadrants corresponding to the receiver mode. These minima are the following:

- FP1R[min aver], FP2R[min aver], FP3R[min aver], FPR[min v]
- cos(φ1)R[min aver], cos(φ2)R[min aver], cos(φ3)R[min aver], cos(φg)R[min aver]

The minima listed above are developed according to the following algorithm:

If $\left(X[moy] < XR[\min moy]\right)$ AND $\left(\mathrm{P}[\mathrm{moy}] \geq 0\right)$

Then $\left(XR[\min moy] = X[moy]\right)$ with X = FP or cos($\varphi_g$).

## 25.22.2 Minima (B)

The products also calculate the minima of average variables in the two quadrants corresponding to the generator mode. These minima are the following:

- $FP_1$G[min aver], FP2G[min aver], FP3G[min aver], FPG[min aver]
- cos(φ1)G[min aver], cos(φ2)G[min aver], cos(φ3)G[min aver], cos(φg)G[min aver]

The minima listed above are developed according to the following algorithm:

If $\left(X[moy] < XG[\min moy]\right)$ AND $\left(\mathrm{P}[\mathrm{moy}] < 0\right)$

Then $\left(XG[\min moy] = X[moy]\right)$
with X = FP or cos(φ).

# 25.23 Calculation of maxima

Each maximum is timestamped (date and time of detection of the maximum). All the maxima can be reinitialized by writing a command word over the local or remote communication. The reinitialization consists of placing the value 0 in the variable, with the exception of the maxima of variables of type $FP_x$ and cos ($\varphi_x$), for which the reinitialization consists of placing the value 1.

# 25.24 Maxima of variables

### 25.24.1 Maxima (A)

The products calculate the maxima of "at the second'' variables in the four quadrants. These maxima are the following:

- $V_1$[max], V2[max], V3[max]
- U12[max], U23[max], U31[max]
- I1[max], I2[max], I3[max], IN[max]
- F[max]
- S1[max], S2[max], S3[max], S[max]

The maxima listed above are developed according to the following algorithm:

If $(X[1s] > X[\max])$

Then $(X[\max] = X[1s])$

with X = $U_{ab}$, $I_L$, F or S ab=12, 23 or 31 L = 1, 2 or 3.

### 25.24.2 Maxima (B)

The products also calculate the maxima of "at the second'' variables in the two quadrants corresponding to receiver mode. These maxima are the following

- $P_1$R[max], $P_2$R[max], P3R[max], PR[max]
- Q1R[max], Q2R[max], Q3R[max], QR[max]

The maxima listed above are developed according to the following algorithm

If $(X[1s] > XR[\max])$ AND $(\mathrm{P}[1s] \geq 0)$

Then $(XR[\max] = X[1s])$ with X = P or Q.

### 25.24.3 Maxima (C)

The products also calculate the maxima of "at the second'' variables in the two quadrants corresponding to generator mode. These maxima are the following:

- $P_1$G[max], P2G[max], P3G[max], PG[max],
- Q1G[max], Q2G[max], Q3G[max], QG[max]

The maxima listed above are developed according to the following algorithm:

If $(X[1s] > XG[\max])$ AND $(\mathrm{P}[1s] < 0)$

Then $(XG[\max] = X[1s])$ with X = P or Q.

# 25.25 Maxima of average variables

### 25.25.1 Maxima (A)

The products calculate the maxima of average variables in the four quadrants. These maxima are the following:

- $V_1$[max aver], V2[max aver], V3[max aver]
- U12[max aver], U23[max aver], U31[max aver]
- I1[max aver], I2[max aver], I3[max aver], IN[max aver]
- Des[aver]
- THDV1[aver], THDV2[aver], THDV3[aver]
- THDU12[aver], THDU23[aver], THDU31[aver]
- THDI1[aver], THDI2[aver], THDI3[aver]
- FCV1[aver], FCV2[aver], FCV3[aver]
- FCI1[aver], FCI2[aver], FCI3[aver]
- S[max aver]

The maxima listed above are developed according to the following algorithm:

If $(X[moy] > X[\max moy])$

Then $(X[\max moy] = X[moy])$

### 25.25.2 Maxima (B)

The products also calculate the maxima of average variables in the two quadrants corresponding to the receiver mode. These maxima are the following:

- PR[max aver], QR[max aver],
- FPR[max aver], cos(φg)R[max aver]

The maxima listed above are developed according to the following algorithm:

If $(X[moy] > XR[\max moy])$ AND $(\mathrm{P}[\mathrm{moy}] \geq 0)$

Then $(XR[\max moy] = X[moy])$

### 25.25.3 Maxima (C)

The products also calculate the maxima of average variables in the two quadrants corresponding to generator mode. These maxima are the following:

- PG[max aver], QG[max aver],
- FPG[max], cos(φg)G[max]

The maxima listed above are developed according to the following algorithm:

If $(X[moy] > XG[\max moy])$ AND $(\mathrm{P}[\mathrm{moy}] < 0)$

Then $(XG[\max moy] = X[moy])$.

# 26. INDEX


%, 26
3/4 wire
  By default, 47
  Configuration, 47
A, 26
Abbreviations, 26
Activation
  Global alarm, 40
Active energy, 26
Active Energy EP-, 34
Active Energy EP+, 33
Active power
  Mathematical formulas, 87
Active power, 26
Address
  ENERIUM, 74
  ModBus, 37
Addresse
  By default, 47
Alarm
  Synchronization, 57
Alarms
  Characteristics, 80
  Icon, 25
  Number, 39
  Relays, 39
  Resetting, 40
  Screen, 39
  Status, 39
Analog cards
  Connection, 67
Analog outputs
  Affected values, 20
  Blocking, 20
  Card, 20
  Min/max values, 20
  Output definition, 20
  unblocking, 20
Analog Outputs
  Characteristics, 80
Apparent energy, 26
Apparent energy I/O-, 34
Apparent energy I/O+, 34
Apparent power, 26
Apparent power, 26
Apparent Power
  Mathematical formulas, 88
ASCII, 46
Automatic scrolling
  Icon, 16, 26
Auxiliary source
  Connection, 68
  Terminal, 19, 20
Auxiliary supply source
  Characteristics, 82
Average current, 26
Average power, 30
Average variable
  Mathematical formulas, 91
Backlighting, 15
Balanced three-phase, 64
Blocking
  Analog outputs, 20
  Pulse, 21
Breakdown, 8
By default
  3/4 wire, 47
  Contrast, 47
  Display, 47
  Electrical network, 47
  Ethernet Communication, 47
  Language, 47
  Password, 47
  Scrolling
  TC primary, 47
  TC secondary, 47
  Time, 47
  TP primary, 47
  TP Secondary, 47
Cable
  RS485, 65
Cables
  Dimension, 63
Cabling (test), 26
Cabling test, 26
Calcul of minima
  Mathematical formulas, 92
Calculation of maxima
  Mathematical formulas, 92
Capacitive network
  Icon, 16, 26
Caracteristics
  Table, 14
Card
  Analog outputs, 20
  Input/Output, 37
  On/Off input/output, 21
  On/Off inputs, 21
  On/Off outputs, 20
CEI 61010-1, 8
Characteristics
  Alarms, 80
  Analog outputs, 80
  Auxiliary supply source, 82
  Current inputs, 81
  Display, 81
  Electrical, 81
  Ethernet, 82
  Information retention, 82
  Keys, 81
  LCD, 81
  Load curves, 80
  Measurements, 79
  Mechanical, 84
  Metrology, 83
  On/Off I/O card, 83
  On/Off input card, 82
  On/Off output card, 83
  Optical interface, 82
  Output analog card, 82
  Recording curves, 80
  RS485, 81
  Voltage inputs, 81
Cleaning, 8
Command word
  LCD, 15
Communication
  Card, 37
  Local or remote, 73
  Remote, 73
Communication ongoing
  Icon, 16
Communication RS 485
  By default, 47
Communication speed, 74
Configuration
  3/4 wire, 47
  Change, 55
  Default values, 47
  Icon, 25
  Password, 45
  Remote communication, 43
  Screen, 43
  TC primary, 46
  TC secondary, 47
  TP Primary, 46
  TP secondary, 46
Configuration change, 55
Connection
  Analog cards, 67
  Auxiliary source, 68
  Cards E/S, 67
  Ethernet, 66
  On/Off I/O cards, 68
  On/Off input cards, 67
  Output cards, 67
  RS485, 65
Contrast
  Adjust level, 45

By default, 47
Dsiplay, 45
Contrast LCD, 15
Contrast level
Adjust, 45
Copyright, 9
Cos(φ)
Mathematical formulas, 88
Current, 30
Fresnel, 52
Harmonics, 50
Mathematical formulas, 87
Transformer, 46
Current input
Terminal, 19
Current inputs
Characteristics, 81
Connections, 63
Terminal, 19
Currents
Display rule, 31
Fresnel, 52
Gauges, 52
Cursor
Move, 17
Customized screens
Icon, 25
Screen, 41
Cutting, 61
Date
Display, 38
Synchronization, 57
Default values
Configuration, 47
Delivery
default values, 47
DHCP, 74
Dimensions, 13
DIN 43700, 13
Display
By default, 47
Characteristics, 81
Contrast, 45
Language, 45
Password, 45
Remote communication, 45
Scrolling, 45
Time, 45
Display rule
Currents, 31
Energies, 35
Frequency, 32
Harmonics, 32
Power, 32
Power factor, 32
Time meter, 32
Voltages, 31
Distributed (neutral), 47
*E.set*, 73
*E.view*, 73
Electric variables, 26
Electrical connection, 63
Electrical network
3/4 wire, 47
By default, 47
Remote communication, 46
TC primary, 46
TC secondary, 47
Electrical parasites, 63
Elementary alarm
Global alarm, 40
Statuts, 40
End of life, 9
Energies
Display rules, 35
Energy
Icon, 25
Screen, 33
Energy and metering
Mathematical formulas, 90
ENERIUM
Accessories, 85
Address, 74
Cuting, 61
Electrical connection, 63
Fixation tableau, 61
Maintenance, 75
Mechanical assembly, 61
Mechanical characteristics, 84
Number, 37
Technical characteristics, 77
Type, 37
Use, 69
*ENERIUM 150*, 13
*ENERIUM 150*
*Comparison*, 14
*ENERIUM 50*, 13
*ENERIUM 50*
*Comparison*, 14
Equation
Global alarm, 40
Ethernet
Address by default, 47
Characteristics, 82
Connection, 66
Gateway, 45
Gateway by defaumt, 47
IP Address, 44
LED, 67
Mask, 44
Mask by default, 47
Remote communication, 44, 74
Terminal, 19, 22
Ethernet Communication
By default, 47
Face
Front, 15
Format, 13
FP, 26
French
Language, 45
Frequency, 26
Display rule, 32
Mathematical formulas, 89
Fresnel 3I, 52
Fresnel 3U, 51
Fresnel 3V, 51
Fresnel and gauges
Icon, 25
Screen, 51
Front
Face, 15
Full duplex, 74
Fuse
Protection, 68
Gateway
By default, 47
Remote communication, 45
Gauges 3I, 52
Gauges 3P, 53
Gauges 3U, 52
Gauges 3V, 52
Generator network
Icon, 16, 26
German
Language, 45
Global alarm
Activation, 40
Blinking, 40
Elementary alarm, 40
Equation, 40
Icon, 16, 26
Relays, 40
Screen, 40
Status, 40
Ground voltage
Fresnel, 51
Mathematical formulas, 87
Guarantee, 9
Half duplex, 73, 74
Harmonic distortion rate, 26
Harmonic rate, 26
Harmonics
Current, 31
Display rules, 32
Icon, 25
Mathematical formulas, 89
Percentage, 49
Ph-Ph voltage, 31
Ranges, 49
Rates, 49
Screen, 49
THD, 49
Harmonics I, 50
Harmonics rate
Mathematical formulas, 89
Harmonics U, 49
Harmonics V, 49
Home screen, 16
Hour, 38
Display, 38
How to, 71
Hub, 66
Hxx Ia, 26
Hxx Uab, 26
Hz, 26
I
Harmonics, 50
Icons
Alarms, 25
Automatic scrolling, 16, 26
Capacitive network, 16, 26
Communication ongoing, 16
Configuration, 25
Customized screens, 25
Energy, 25
Fresnel and gauges, 25
Generator network, 16, 26
Global alarm, 16, 26
Harmonics, 25
Inductive network, 16, 26

Measure, 25
Ongoing communication, 26
Phase order, 26
Phase order, 16
Services, 25
In, 26
In load, 38
Indicators
Recording curves, 58
Inductive network
Icon, 16, 26
Information
Retention duration, 82
Information retention
Characteristics, 82
Installation, 59
Cleaning, 8
Instructions, 8
Installation Category, 8
Instantaneous current, 26
Instantaneous ground voltage, 49
Integration time, 55
IP address
Remote communication, 44
IP address
By default, 47
Italian
Language, 45
Ix, 26
JBus
Address, 44
Key
navigation, 17
OK, 17
Keys
Characteristics, 81
kVAh, 26
kVARh, 26
kWh, 26
Language
By default, 47
Display, 45
French, Italian, German, Spanish, 45
LCD, 15
Backlighting, 15
Blinking, 40
Characteristics, 81
Command word, 15
Contrast, 15
Stop blinking, 40
LCD screen, 15
LCD Screen, 15
LED Ethernet, 67
Line voltage
Fresnel, 52
Line voltages
Mathematical formulas, 87
Load curves
Screen, 55
Local communication
Optical interface, 73
Loss of synchronization, 55
Maintenance
ENERIUM, 75
Management
On/Off inputs, 21
On/Off outputs, 21
*Manumesure*, 75
Mask
By default, 47
Remote Communication, 44
Mathematical formulas
Apparent Power, 88
Energy and metering, 90
Frequency, 89
Harmonics rate, 89
Line voltages, 87
Maxima of variables, 93
Peak factor, 89
Phase order, 90
Power factor, 88
Reactive power, 88
Unbalance, 90
Mathematical formulas
Ground voltage, 87
Mathematical formulas
Current, 87
Mathematical formulas
Active power, 87
Mathematical formulas
Transit direction of powers, 88
Mathematical formulas
Cos(φ), 88
Mathematical formulas
Tan(φ), 89
Mathematical formulas
Harmonics, 89
Mathematical formulas
Time meter, 91
Mathematical formulas
Average variable, 91
Mathematical formulas
Calculation of minima, 92
Mathematical formulas
Minima of variables, 92
Mathematical formulas
Calculation of maxima, 92
Mathematical formulas
Maxima of average variables, 93
Maxima of average variables
Mathematical formulas, 93
Maxima of variables
Mathematical formulas, 93
Maximum average current, 30
Measured variables, 87
Measurements
Screen, 29
Measures
Icon, 25
Mecchanical assembly, 61
Mechanical
Characteristics, 84
Menu
Main, 15, 25
Move, 17
Menus
Synoptic, 26
Mesurements
Characteristics, 79
Meters
Active energy, 33
Apparent energy, 34
Initialize, 21
Reactive energy, 34
Metrology
Characteristics, 83
Minima of variables
Mathematical formulas, 92
ModBus/RTU, 73
Mono-phase, 65
Move
Cursor, 17
Menu, 17
MVAh, 26
MVARh, 26
MWh, 26
Navigation
Key, 17
Navigation key, 15
Neutral
Distributed, 47
Non-distributed, 47
Neutral current, 26
Non-distributed (neutral), 47
Number ENERIUM, 37
oad curves
Characteristics, 80
OK, 15
Key, 17
OK key, 15
On/Off I/O card
Characteristics, 83
On/Off I/O cards
Connection, 68
On/Off input
Synchronization, 57
On/Off input card
Characteristics, 82
On/Off input cards
Connection, 67
On/Off input/output
Card, 21
On/Off inputs
Card, 21
Management, 21
Pulse mode, 21
Synchronization mode, 21
On/Off output card
Characteristics, 83
On/Off output cards
Connection, 67
On/Off outputs
Card, 20
On/Off outputs
Alarm mode, 21
On/Off outputs
Max/min threshold, 21
On/Off outputs
Pulsed mode, 21
On/Off outputs
Mode Associate output, 21
On/Off outputs
Relays, 21
On/Off outputs
Management, 21
Ongoing communication
Icon, 26
Operating procedure, 71
Operating time, 38
Operators' safety, 8

Optical
Cable, 17
Interface, 16
Optical cable, 17
optical interface
Local communication, 73
Optical interface, 15, 16
Characteristics, 82
Optional card
Terminal, 19, 20
Output
Associate On/Off outputs, 21
Output analog card
Characteristics, 82
P, 26
Packaging, 10
Par default
Communication RS 485, 47
Parity
By default, 47
Remote communication, 44
Password
0000, 46
By default, 47
Configuration, 45
Display, 45
Time lag, 46
Peak factor
Mathematical formulas, 89
Percentages of harmonics, 49
Period
Recording curves, 57
Phase order
Mathematical formulas, 90
Phase order
Icon, 16, 26
Phase shift
Fresnel (gound current), 52
Fresnel (ground voltage), 51
Fresnel (line voltage), 52
Ph-N voltage, 29
Ph-Ph Voltage, 29
Pmoy, 26
Polarity
Supply, 68
Power, 30
Display rule, 32
Power factor
Mathematical formulas, 88
Power factor, 26
Display rule, 32
Powers
Gauges, 53
Presence network, 38
Presentation, 13
Product information, 37
Property rights, 9
Protection
Electrical parasites, 63
Fuse, 68
Voltage inputs, 63
Pulse
Blocking, 21
On/Off inputs, 21
Tally, 21
Weight, 21
Width, 21
Pulsed mode
Associate output, 21
On/Off outputs, 21
Tally, 21
Q, 26
Ranges of harmonics, 49
Rates of harmonics, 49
RAZ
Status word for alarms, 40
Reactive energy, 26
Reactive Energy EQ, 34
Reactive power
Mathematical formulas, 88
Reactive power, 26
Real composed voltage, 26
Real RMS voltage, 26
Recorded variables, 57
Recording
Depth, 55, 57
Recording curves
Characteristics, 80
Continuous mode, 57
Filling rate, 58
Indicators, 58
Mode buffer stop, 57
Mode with immediate stop, 58
Mode with stop centered 25, 58
Mode with stop centered 50, 58
Operating modes, 57
Period, 57
Screen, 57
Recording period, 57
Registered trademarks, 9
Relays
Alarm (associated), 39
Global alarm, 40
On/Off outputs, 21
Remote communication
Display, 45
Electrical network, 46
Ethernet, 44, 74
Gateway, 45
IP address, 44
JBus address, 44
Mask, 44
Parity, 44
Reversal, 44
RS 485, 43
RS485, 73
Speed, 44
Remote Communication
Configuration, 43
Stop bit, 44
Resetting
Alarms, 40
Resistance
Polarization, 66
Reversal
By default, 47
Remote communication, 44
RJ 45, 66
RS 485
Addresse by default, 47
JBus Address, 44
Parity, 44
Parity by default, 47
Remote communication, 43
Reversal, 44
Reversal by default, 47
Speed, 44
Speed by default, 47
Stop bit, 44
Stop bit by default, 47
RS232, 66
RS485, 37
Characteristics, 81
Connection, 65
Output, 65
Polarization resistance, 66
Remote communication, 73
Terminal, 19, 21
Transmission format, 74
S, 26
Safety, 8
Screen
Alarms, 39
Configuration, 43
Customized screens, 41
Energy, 33
Fresnel and gauges, 51
Global alarm, 40
Harmonics, 49
Home, 25
Load curves, 55
Measurements, 29
Recording curves, 57
Resetting alarms, 40
Services, 37
Screen number
Read, 16
Scrolling
Automatic, 45
By default, 47
Display, 45
Services
Icon, 25
Screen, 37
Shielded twisted cable, 66
Simple voltage, 26
Smoy, 26
Spanish
Language, 45
Speed
By default, 47
Remote communication, 44
Status
Global alarm, 40
Status word for alarms, 40
Stop bit
By default, 47
Remote communication, 44
Supply
Alternative, 20
Continuous, 20
High level, 20, 68
Low level, 20, 68
Polarity, 68
Switch, 66
Synchronization
Loss, 55
Modes, 57
On alarm, 57
On date, 57
On On/Off input, 57

On/Off inputs, 21
Return, 55
Types, 57
Synchronization return, 55
Synoptic of menus, 26
Table characteristics, 14
Tan(φ)
Mathematical formulas, 89
TC primary
By default, 47
Configuration, 46
TC secondary
By default, 47
TC secondary
Configuration, 47
Technical Characteristics, 77
Terminal
Auxiliary source, 19
Auxiliary Source, 20
Current input, 19
Current inputs, 19
Ethernet, 19, 22
Optional card, 19, 20
RS485, 19, 21
Voltage input, 19
Terminals
Types, 63
D, 49
Current, 31
Ph-Ph voltage, 30
D Ix, 26
ne
By default, 47
Display, 45
Time meter
Mathematical formulas, 91
Time meter
In load, 38
Information display, 38
Network presence, 38
Operating time, 38
TP primary
By default, 47
Configuration, 46
Electrical network
TP Primary
Configuration, 46
TP secondary
By default, 47
Configuration, 46
TP Secondary
Electrical network, 46
Transfer
PC-ENERIUM, 22
Transformer
Voltage, 46
Transit direction of powers
Mathematical formulas, 88
Transmission format
RS485, 74
Twiested cable torsadé, 65
Type ENERIUM:, 37
U
Harmonics, 49
unbalance, 52
Unbalance
Mathematical formulas, 90
Unbalance rate, 52
Unbalanced three-phase, 63, 64, 65
Unblocking
Analog outputs, 20
Units, 26
Use, 69
V, 26
Harmonics, 49
VA, 26
VAR, 26
Voltage, 26
Voltage input
Terminal, 19
Voltage inputs
Characteristics, 81
Connections, 63
Protection, 63
Voltage U
Harmonics, 49
Voltage V
Harmonics, 49
Voltages
Display rule, 31
Time meter, 32
Voltages U
Gauges, 51, 52
Voltages V
Gauges, 51, 52
W, 26
Weight
Pulse, 21
Width
Pulse, 21

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